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Principal Forage Plants of Southwestern Ranges

by

B. Ira Judd



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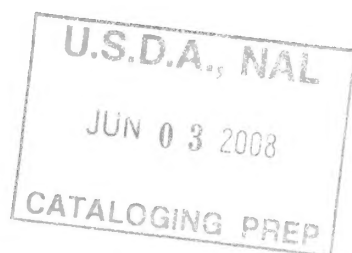


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PRINCIPAL FORAGE PLANTS OF SOUTHWESTERN RANGES

by

B. Ira Judd¹C O N T E N T S

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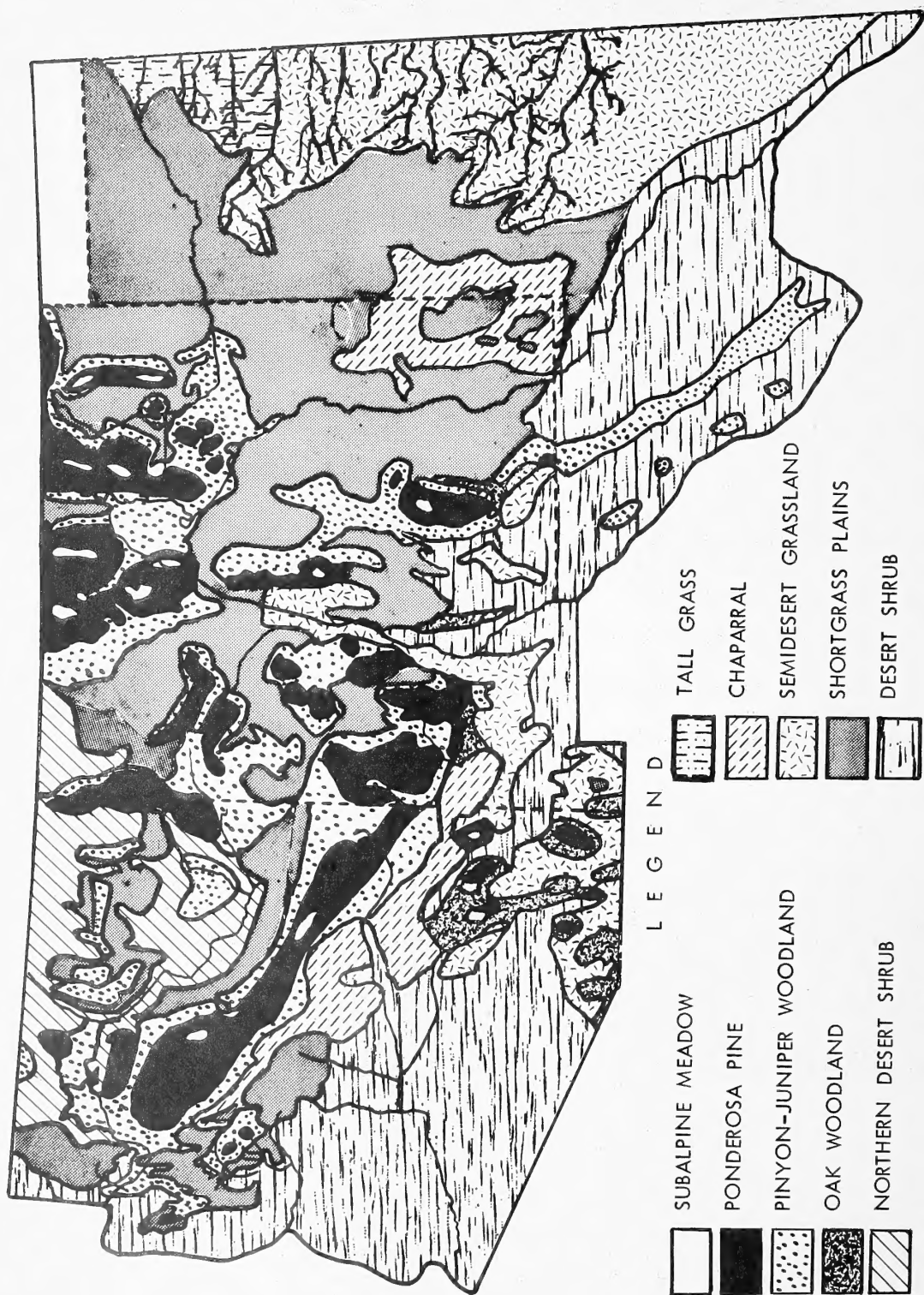


Figure 1. --Major vegetation types of the Southwest.

PRINCIPAL FORAGE PLANTS
OF
SOUTHWESTERN RANGES

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- - -

Forage on the range is the crop for livestock and wildlife. Thus the kinds of plants that grow on a range determine its worth. If a range manager is to realize the fullest potential of his forage resource, he must be well acquainted with the plants. By knowing which of the many species are desirable and palatable he can decide whether his area is producing as it should. The species described are useful indicators of conditions of rangelands (fig. 1) of the Southwest. Species of major importance in the various vegetation types, and those especially characteristic of the type are listed in table 1.

TYPES OF RANGELANDS IN THE SOUTHWEST

SUBALPINE MEADOW

The subalpine meadow is probably the most productive forage type in the Southwest, and although small in aggregate area, it provides important summer forage for livestock and game. Meadows (fig. 2) characteristically are parklike openings in spruce-fir forests between 9,000 feet elevation and timberline.



Figure 2. --A high mountain meadow in good condition.

Table 1. --List of major species and genera discussed in this Station Paper with the types in which they mainly occur and the page reference of the description

- | | | |
|-----------------------------|---------------------------|--------------------------|
| (1) Subalpine meadow | (4) Oak woodland | (7) Semidesert grassland |
| (2) Ponderosa pine | (5) Northern desert shrub | (8) Short-grass plains |
| (3) Pinyon-juniper woodland | (6) Chaparral | (9) Desert shrub |

Scientific name	Common name	Page No.	Major range types								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GRASSES AND GRASSLIKE PLANTS:											
<u>Agropyron smithii</u> Rydb.	Western wheatgrass	13		x	x		x	x		x	
<u>A. trachycaulum</u> (Link) Malte	Slender wheatgrass	14	x	x							
<u>Agrostis alba</u> L.	Redtop	15	x	x							
<u>Andropogon barbinodis</u> Lag.	Cane bluestem	16				x		x	x	x	
<u>A. cirratus</u> Hack.	Texas bluestem	19			x	x		x			
<u>A. gerardii</u> Vitman	Big bluestem	18				x				x	
<u>A. hallii</u> Hack.	Sand bluestem	18								x	
<u>A. saccharoides</u> Swartz	Silver bluestem	17				x		x	x	x	
<u>A. scoparius</u> Michx.	Little bluestem	17		x	x	x				x	
<u>Aristida arizonica</u> Vasey	Arizona three-awn	20		x	x						
<u>Blepharoneuron tricholepis</u> (Torr.) Nash	Pine dropseed	21	x	x	x						
<u>Bouteloua chondrosioides</u> (H. B. K.) Benth.	Sprucetop grama	22				x			x		
<u>B. curtipendula</u> (Michx.) Torr.	Side-oats grama	23			x	x	x	x	x	x	
<u>B. eriopoda</u> Torr.	Black grama	24			x	x		x	x	x	
<u>B. filiformis</u> (Fourn.) Griffiths	Slender grama	25				x			x		
<u>B. gracilis</u> (H. B. K.) Lag.	Blue grama	26		x	x	x	x	x	x	x	
<u>B. hirsuta</u> Lag.	Hairy grama	27			x	x		x	x	x	
<u>B. rothrockii</u> Vasey	Rothrock grama	28							x	x	
<u>Bromus</u> spp.	Perennial brome-grasses	29	x	x							
<u>Buchloe dactyloides</u> (Nutt.) Engelm.	Buffalograss	30								x	
<u>Carex</u> spp.	Sedges	31	x	x	x	x		x		x	
<u>Danthonia intermedia</u> Vasey	Timber danthonia	32	x	x							
<u>Deschampsia caespitosa</u> (L.) Beauv.	Tufted hairgrass	33	x	x							
<u>Elymus canadensis</u> L.	Canada wildrye	34		x	x			x		x	
<u>Eragrostis intermedia</u> Hitchc.	Plains lovegrass	35				x		x	x	x	
<u>Festuca arizonica</u> Vasey	Arizona fescue	36	x	x							
<u>F. ovina</u> L.	Sheep fescue	37	x								
<u>F. thurberi</u> Vasey	Thurber fescue	38	x								
<u>Heteropogon contortus</u> (L.) Beauv.	Tanglehead	39			x	x		x	x		
<u>Hilaria belangeri</u> (Steud.) Nash	Curlymesquite	40			x	x		x	x		
<u>H. jamesii</u> (Torr.) Benth.	Galleta	41			x		x		x	x	
<u>H. mutica</u> (Buckl.) Benth.	Tobosa	42							x	x	
<u>Juncus</u> spp.	Rushes	43	x	x							
<u>Koeleria cristata</u> (L.) Pers.	Prairie Junegrass	44	x	x	x	x	x	x		x	
<u>Leptochloa dubia</u> (H. B. K.) Nees	Green sprangletop	45				x		x	x		
<u>Lycurus phleoides</u> H. B. K.	Wolf-tail	46			x	x		x	x		
<u>Muhlenbergia emersleyi</u> Vasey	Bullgrass	47		x	x	x		x			
<u>M. montana</u> (Nutt.) Hitchc.	Mountain muhly	47		x	x						
<u>M. porteri</u> Scribn.	Bush muhly	48							x	x	
<u>M. wrightii</u> Vasey	Spike muhly	49		x	x	x					
<u>Oryzopsis hymenoides</u> (Roem. & Schult.) Ricker	Indian ricegrass	50			x			x			
<u>Panicum obtusum</u> H. B. K.	Vine-mesquite	51			x	x			x	x	
<u>Poa fendleriana</u> (Steud.) Vasey	Mutton bluegrass	52		x	x		x	x			
<u>P. longiligula</u> Scribn. & Williams	Long-tongue mutton bluegrass	52			x	x		x			
<u>P. pratensis</u> L.	Kentucky bluegrass	53	x	x							
<u>Setaria macrostachya</u> H. B. K.	Plains bristlegrass	54						x	x	x	

Table 1. --List of major species and genera discussed in this Station Paper with the types in which they mainly occur and the page reference of the description (continued)

(1) Subalpine meadow	(4) Oak woodland	(7) Semidesert grassland
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Scientific name	Common name	Page No.	Major range types								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<u>Sitanion hystrix</u> (Nutt.) J. G. Smith	Bottlebrush squirreltail	55	x	x	x	x	x	x		x	
<u>Sporobolus airoides</u> Torr.	Alkali sacaton	56					x		x	x	
<u>S. cryptandrus</u> (Torr.) A. Gray	Sand dropseed	57		x	x	x	x	x	x	x	
<u>S. interruptus</u> Vasey	Black dropseed	58		x							
<u>Stipa columbiana</u> Macoun	Subalpine needlegrass	59	x	x							
<u>S. comata</u> Trin. & Rupr.	Needle-and-thread	60		x	x		x			x	
<u>S. neomexicana</u> (Thurb.) Scribn.	New Mexican feathergrass	60			x			x		x	
<u>Trichachne californica</u> (Benth.) Chase	Arizona cottontop	61				x		x	x		
FORBS:											
<u>Agoseris</u> spp.	Agoseris	62	x	x							
<u>Crepis</u> spp.	Hawksbeards	63		x	x			x			
<u>Cymopterus fendleri</u> A. Gray	Chimaya	64	x	x	x					x	
<u>Erodium cicutarium</u> (L.) L'Her.	Alfilaria	64, 65				x		x	x		x
<u>Geranium</u> spp.	Geraniums	66	x	x							
<u>Hieracium</u> spp.	Hawkweeds	67	x	x							
<u>Lathyrus</u> spp.	Peavines	68	x	x	x						
<u>Lotus wrightii</u> (A. Gray) Greene	Wright deervetch	69		x	x	x		x			
<u>Mertensia</u> spp.	Bluebells	70	x	x							
<u>Plantago purshii</u> Roem. & Schult.	Woolly Indianwheat	71				x	x	x	x	x	x
<u>Trifolium</u> spp.	Clovers	72	x	x							
<u>Vicia americana</u> Muhl.	American vetch	73	x	x							
TREES AND SHRUBS:											
<u>Amelanchier</u> spp.	Serviceberry	74		x	x	x		x			
<u>Artemisia tridentata</u> Nutt.	Big sagebrush	75					x				
<u>Atriplex canescens</u> (Pursh) Nutt.	Fourwing saltbush	76			x		x		x	x	x
<u>Baccharis wrightii</u> A. Gray	Wright baccharis	77							x		x
<u>Calliandra eriophylla</u> Benth.	False-mesquite	77				x		x	x		
<u>Ceanothus fendleri</u> A. Gray	Fendler ceanothus	78		x	x						
<u>C. greggii</u> A. Gray	Desert ceanothus	79			x	x		x			
<u>Cercocarpus breviflorus</u> A. Gray	Hairy cercocarpus	80			x	x		x			
<u>C. montanus</u> Raf.	True cercocarpus	80		x	x	x					
<u>Cowania mexicana</u> D. Don	Cliffrose	81		x	x	x		x			
<u>Eriogonum wrightii</u> Torr.	Wright eriogonum	82			x	x		x			
<u>Eurotia lanata</u> (Pursh) Moq.	Winterfat	83			x		x			x	
<u>Fallugia paradoxa</u> (D. Don) Endl.	Apache-plume	84			x	x		x			
<u>Garrya wrightii</u> Torr.	Wright silktassel	85			x	x		x			
<u>Krameria parvifolia</u> Benth.	Littleleaf krameria	86						x	x		
<u>Menodora scabra</u> A. Gray	Rough menodora	86			x	x		x	x		
<u>Opuntia</u> spp.	Cacti	86, 87, 88			x	x		x	x	x	x
<u>Prosopis</u> spp.	Mesquite	89				x			x		x
<u>Purshia tridentata</u> (Pursh) DC	Bitterbrush	90		x	x						
<u>Quercus gambelii</u> Nutt.	Gambel oak	91		x	x			x			
<u>Q. turbinella</u> Greene	Shrub live oak	92						x			
<u>Simmondsia chinensis</u> (Link) Schneid.	California jojoba	93						x			x

end of list

Average annual precipitation is from 30 to 35 inches. Growing season is short, with frost-free period usually not more than 90 days. Soils are usually fine-textured alluviums that are easily compacted and often poorly drained. Well-drained meadows are often subject to summer drought.

The vegetation consists of a lush growth of grasses, grasslike plants, and forbs. Where the soil moisture is high throughout the growing season, sedges (*Carex* spp.) and rushes (*Juncus* spp.) dominate the plant population. On areas that are somewhat drier, at least part of the season, tufted hairgrass (*Deschampsia caespitosa* (L.) Beauv.) and several fescues (*Festuca* spp.) are common. Browse plants usually are not abundant.

Where cattle grazing has been too heavy, forbs become more prominent, although these areas usually present a grassy aspect. As deterioration becomes greater the larger bunchgrasses and sedges are replaced by a thin cover of smaller less palatable grasses and forbs. On sheep ranges coarse grasses may become predominant.

To keep subalpine meadows highly productive, soils should be kept in place and gully erosion prevented. Drainage channels should have smooth contours without signs of raw soil banks or gully cutting. If plants become pedestaled and litter does not accumulate, abnormal amounts of bare soil may be exposed to forces of erosion. As the soil begins to move, small rills form, which later develop into gullies. The gullies drain the soil moisture and prevent satisfactory maintenance of the desirable plants. These, as well as other conditions, are indicators of poor range conditions.

PONDEROSA PINE



Figure 3. --Open forest range in satisfactory condition supports a stand of desirable forage grasses.

The open ponderosa pine forest type extends through the northern and central portions of Arizona and north and west-central New Mexico. Elevations vary from 6,500 to 11,500 feet. Annual precipitation ranges from 20 to 30 inches. Where the forest is dense as in thickets of young ponderosa pine, there is little or no herbaceous understory. Mostly, however, the forest canopy is sufficiently open for an understory of herbaceous forage plants (fig. 3).

Large bunchgrasses should comprise the bulk of the forage. Most important are Arizona fescue (Festuca arizonica Vasey) and mountain muhly (Muhlenbergia montana (Nutt.) Hitchc.). Other bunchgrasses and a few palatable weeds should also be found on ponderosa pine range in productive condition. Blue grama (Bouteloua gracilis (H.B.K.) Lag.), which produces much less forage than the larger grasses, should not be abundant but often is on heavily grazed range.

Herbaceous forage plants are most abundant in the openings and in the scattered timber stands, and least abundant in the dense parts of the forest. The species of plants present are much the same regardless of the timber overstory.

Stringers of rock outcroppings form ridges and abrupt ledges in many places throughout the forests. Shrubs are common on these sites, particularly cliffrose (Cowania mexicana D. Don), a valuable browse.

PINYON-JUNIPER WOODLAND

This range type, characterized by pinyon pine and several species of juniper or "cedar" extends from the ponderosa pine forest down to about 4,500 feet elevation. Rainfall varies from 12 to 18 inches. Long, narrow tongues of ponderosa pine forest extend into this type where growing conditions are favorable. Also, scattered islands of pinyon and juniper may cover the knolls and eminences which break the plateaulike topography of the sagebrush type and higher areas of the short-grass type.

The pinyon-juniper type originally was prominent on rocky ridges and shallow soils but also occupied some of the better soils. Since settlement, the type has thickened and spread to many former grassland areas.

Often pinyon and juniper form such dense stands as to exclude most other plants. In other places the type is more open, and permits a sod of palatable grasses (fig. 4). Side-oats grama (Bouteloua curtipendula (Michx.) Torr.), blue grama, western wheatgrass (Agropyron smithii Rydb.), longtongue mutton bluegrass (Poa longiligula Scribn. & Williams), mutton bluegrass (P. fendleriana (Steud.) Vasey), and galleta (Hilaria jamesii (Torr.) Benth.) are possibly the most important in the open areas. On pinyon-juniper ranges which have been properly managed, these and other desirable species grow in a mixture. Frequently Wright deervetch (Lotus wrightii (A. Gray) Greene) is mingled with the grasses.

If the terrain is rough and rocky, shrubs may be important. Cercocarpus (Cercocarpus spp.), cliffrose, serviceberries (Amelanchier spp.), and Apache-plume (Fallugia paradoxa (D. Don) Endl.) are the most common browse. Two



Figure 4. --Pinyon-juniper woodland in thrifty condition supports a productive forage understory.

small desirable shrubs, rough menodora (Menodora scabra A. Gray) and Wright eriogonum (Eriogonum wrightii Torr.) are interspersed with the larger ones. When the soil is alkaline, fourwing saltbush (Atriplex canescens (Pursh) Nutt.) may be present.

OAK WOODLAND

The oak woodland type occupies the foothills and mountains in southern New Mexico and in southeastern and central parts of Arizona between 4,500 and 6,000 feet elevation. The annual precipitation is from 12 to 18 inches. Various oaks characterize the vegetation. Some junipers, other small trees, and shrubs are often interspersed. Since trees and shrubs seldom form dense stands, there is a vigorous understory of grasses that forms a complete ground cover on ranges in healthy condition (fig. 5). The aspect is often that of a grassland savannah.

The gramas, many of the bluestems (Andropogon spp.), curlymesquite (Hilaria belangeri (Steud.) Nash), the tall three-awns (Aristida spp.), tangle-head (Heteropogon contortus (L.) Beauv.), green sprangletop (Leptochloa dubia (H. B. K.) Nees), bottlebrush squirreltail (Sitanion hystrix (Nutt.) J. G. Smith), and longtongue mutton bluegrass are possibly the more prominent grass species found in this type.

Among the more common browse species are cliffrose, false-mesquite (Calliandra eriophylla Benth.), desert ceanothus (Ceanothus greggii A. Gray), cercocarpus, Apache-plume, Wright silktassel (Garrya wrightii Torr.), and serviceberries. Two palatable half-shrubs, rough menodora and Wright eriogonum, are often interspersed among the grasses and larger browse.

Wright deervetch is the most prominent forb.



Figure 5. --Desirable forage grasses form a dense cover on oak woodland ranges in good condition.

Continued heavy use causes a gradual replacement of the more palatable grass species by less desirable ones such as the three-awns. The palatable browse species eventually give way to nonpalatable chaparral under extreme conditions of grazing use. Since these changes from the more to the less desirable plants take place slowly, the soil is often left exposed, which permits the inroads of erosion.

NORTHERN DESERT SHRUB

The northern desert shrub or sagebrush range of the Southwest is confined largely to that region in Arizona north of the Colorado and Little Colorado Rivers, known locally as the "Strip," and to the northwestern part of New Mexico. Average elevation is about 4,000 feet. Average precipitation is about 10 inches annually, with a variation from 5 to 14 inches.

Vast areas of this type, where the soils are alkali-free, are covered with big sagebrush (Artemisia tridentata Nutt.). Blackbrush (Coleogyne ramosissima Torr.), fourwing saltbush, and winterfat (Eurotia lanata (Pursh) Moq.) are important locally. The latter two are desirable browse plants.

Productive sagebrush ranges support an understory of forage grasses (fig. 6). Western wheatgrass and blue grama are common components. The flood plains support alkali sacaton (Sporobolus airoides Torr.).



Figure 6. --Sagebrush range. Under proper management this type can produce considerable forage.

CHAPARRAL

The most extensive and continuous areas of chaparral in the Southwest lie south of the main ponderosa pine forests in the mountains of central Arizona, where the mountain slopes drop away suddenly to lower elevations with higher temperatures. Smaller bodies of typical chaparral are found throughout southern and eastern Arizona on the slopes of the isolated mountain ranges. The rainfall ranges from 13 to 25 inches annually. The elevation varies from 3,500 to 5,500 feet.

Shrubs and stunted trees form an almost impenetrable cover over much of the area. Shrub live oak (Quercus turbinella Greene) is the dominant species in Arizona. At the higher elevations various species of ceanothus (Ceanothus spp.) are the outstanding browse plants. Adjoining the desert, thickets of California jojoba (Simmondsia chinensis (Link) Schneid.) are common. Between these two extremes a number of other palatable shrubs are found, such as the various species of cercocarpus, Wright silktassel, littleleaf krameria (Krameria parvifolia Benth.), and rough menodora.

To be highly productive, chaparral range must be fairly open so that forage grasses can occupy the small openings (fig. 7). Spike muhly (Muhlenbergia wrightii Vasey), curlymesquite, side-oats grama, and blue grama commonly occupy openings in the chaparral.



Figure 7. --Grasses as well as palatable browse occur on chaparral ranges in good condition.

SEMIDESERT GRASSLAND

Semidesert grassland range extends from western Texas and the southern parts of New Mexico to southeastern Arizona. The elevation varies from 3,000 to 5,000 feet. Precipitation averages 12 inches a year, with the greater part coming during the months of July, August, and September. Growth is rapid during this rainy season. About 90 percent of the perennial grass herbage is produced at that time.

On sandy soils, especially in southern New Mexico, semidesert grasslands in good condition are dominated by black grama (Bouteloua eriopoda Torr.) Elsewhere, black grama occurs in a mixture with a great many other species of perennial gramas and other grasses (fig. 8). Curlymesquite is characteristic of the open parks of the foothills, with sacaton (Sporobolus wrightii Munro) along the drainageways and tobosa (Hilaria mutica (Buckl.) Benth.) prominent on the flood flats.

A number of palatable shrubs, chief of which are Wright baccharis (Baccharis wrightii A. Gray), Wright eriogonum, Apache-plume, and false-mesquite, grow commonly in this range type. These shrubs add variety to the forage and are especially relished by livestock in the winter and spring. Shrubs are more abundant at the lower than at the higher elevations on semidesert grassland ranges.

In recent years many undesirable shrubs such as mesquite (primarily varieties of Prosopis juliflora (Swartz) DC.), chollas and pricklypear cacti (Opuntia spp.), and burroweed (Haplopappus tenuisectus (Greene) Blake) have gained prominence. As shrubs become dense, grazing values decrease.



Figure 8. --Gramas and other grasses are important forage plants on semi-desert grasslands.

SHORT-GRASS PLAINS

The short-grass type is confined mainly to parts of eastern, central, and northern New Mexico, northern Arizona, and western Texas. The average elevation is 3,500 feet, while the mean annual precipitation is about 17 inches. About 70 percent of the total rainfall falls between April and September.

Short-grass ranges that are flourishing are highly productive. Slight variations in climate, soil, exposure, and other site factors result in differences in species composition, but always on properly managed ranges the aspect is one of a vigorous mixture of productive grasses (fig. 9).



Figure 9. --Short-grass ranges which are thrifty provide a mixture of palatable forage grasses.

Blue grama is the predominant grass of the shortgrass type. Side-oats grama, hairy grama (*Bouteloua hirsuta* Lag.), and galleta are also prominent locally, especially on coarser soils and gravelly slopes.

Big bluestem (Andropogon gerardii Vitman) is sometimes common on heavier soils where moisture is more favorable, while sand bluestem (A. hallii Hack.) occupies the lighter sandy soils. Little bluestem (A. scoparius Michx.) is most common on coarse soils and rocky slopes.

Buffalograss (Buchloe dactyloides (Nutt.) Engelm.) occupies the heavier soils, especially if these receive runoff. In the warmer portion of this range type, buffalograss gives way to vine-mesquite (Panicum obtusum H. B. K.) which is also more common on the heavier, adobe soils. Alkali sacaton grows on the alkali soils of the meadows, valleys, and flood plains. Sacaton is found on the same general sites where soils are alkali-free.

DESERT SHRUB

The desert shrub type is confined mainly to the southwestern third of Arizona, an area of about 24 million acres. Precipitation varies from 3 to 12 inches, but averages 6 inches. Elevations range from 137 to 3,000 feet. Evaporation and summer temperatures are high.

The most common dominant shrubs are creosotebush (Larrea tridentata (DC.) Coville), paloverdes (Cercidium spp.) and cacti, although many others are found. Most of the shrubs are poor forage plants.

Although forage production is usually low and uncertain, in some years ranges that have been maintained in productive condition have some grazing value (fig. 10). The tall three-awns occur sparingly along the intermittent drainageways. In the alkali flats, where the salt concentration is not too high, various saltbushes (Atriplex spp.) provide good browse. On the higher rocky foothills, which are interspersed in this type, Wright baccharis, Wright eriogonum, and California jojoba afford good grazing. In the event of favorable winter or early spring moisture, alfilaria (Erodium cicutarium (L.) L'Her.) and woolly Indianwheat (Plantago purshii Roem. & Schult.) furnish considerable annual forage.



Figure 10. --In the desert shrub type, drought-resistant grasses and annuals provide limited grazing.

DESCRIPTIONS OF IMPORTANT AND DESIRABLE SPECIES

Brief descriptions and economic notes are given for 89 species and genera and most are illustrated. These are the important forage and browse plants that produce the bulk of the usable herbage on Southwestern ranges. They are only a small part of the total number of plants that grow in the area. For further information about the economic values of the species and genera discussed, the reader is referred to the Range Plant Handbook,² Notes on Western Range Forbs,³ and Important Western Browse Plants.⁴

² U. S. Forest Service. Range plant handbook. U. S. Dept. Agr. illus. Washington, D. C. 1937. (Revised 1940.)

³ Dayton, William A. Notes on western range forbs. Equisetaceae through Fumariaceae. U. S. Dept. Agr. Agr. Handb. 161, 254 pp., illus. 1960.

⁴ _____ Important western browse plants. U. S. Dept. Agr. Misc. Pub. 101, 214 pp., illus. 1931.

Western wheatgrass, also known as bluestem wheatgrass, is an erect, rigid, perennial sod-former growing from 1 to 4 feet tall. The stems and leaves are often covered with a waxy coating which gives them a blue-green color. The leaf blades are bluish green to green in color, harsh, rigid, and very rough on the upper surface. The ligule is short, membranous, and slightly toothed. The seed head is a long, slender spike, much like that of awnless wheat.

Western wheatgrass reproduces by long, slender rhizomes, as well as by seed. The rhizomes may grow 3 or 4 feet in one growing season. It develops a coarse, heavy sod under favorable conditions.

This species is best adapted to well-drained bottom land, or old lake beds. However, it does well on a variety of soils, including alkali, and is drought resistant. Western wheatgrass is a primary forage species on good-condition ranges of the pinyon-juniper, chaparral, northern desert shrub, and short-grass plains types. It is also found in the ponderosa pine type but is less conspicuous here because taller grasses characterize the range vegetation.

Western wheatgrass is a cool-season grass that produces fresh forage early in the spring before the warm-season growing grasses become green. In spite of the stiff leaves the plant rarely becomes too coarse and rank to discourage animals from grazing it. Too, proper grazing tends to prevent this species from becoming overly coarse. Sheep are particularly fond of the seed heads. Western wheatgrass cures well on the ground and provides good winter forage. Deer and elk graze this species early in the season.



Figure 11. --Agropyron smithii Rydb. (Western wheatgrass)



Slender wheatgrass, a short-lived, native perennial bunchgrass, commonly reaches a height of from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet. Under favorable conditions plants may be taller. The dense bunches may become as large as a foot in diameter. The flowering stems are numerous, erect, and rather coarse. The leaves are usually smooth. Leaves and stems often have a purplish bloom. The seed head is a slender greenish spike. This spike is more slender than the other common wheatgrasses.

Slender wheatgrass is one of the most palatable and nutritious of the wheatgrasses and is relished early in the spring by all classes of livestock including elk and deer. Sheep do not graze the mature herbage readily, but do like the seed heads.

Growth starts early in the spring, but sometimes the plants remain green and palatable until late fall. It will withstand a reasonable amount of grazing and trampling. Although it is commonly the main forage species on dry mountain meadows, other associated grasses such as Arizona and Thurber fescues are often more noticeable in other types when in good condition. It is most common in the subalpine meadow and ponderosa pine types.

Figure 12. --Agropyron trachycaulum (Link) Malte (Slender wheatgrass)

Redtop is not a native of the Southwest, but is mentioned here because of its importance in the range types mentioned below. Originally introduced into the United States from Europe as a cultivated species, it has since become widespread on many rangelands. It is commonly found in moist meadows within the ponderosa pine and spruce-fir forests and subalpine meadow type when the meadows are in good condition.

Redtop is a perennial grass with a creeping habit of growth, which makes a coarse, loose turf. The slender stems are from 8 to 36 inches high. The leaves are numerous and flat, about $\frac{1}{4}$ inch wide and mostly basal. The seed head is a loose panicle, pyramidal in shape, from 2 to 12 inches long, and usually reddish in color.

The palatability of redtop is usually rated good to very good for cattle and horses, and from fairly good to good for sheep. If moisture is available, the plants usually remain green all summer and can be grazed throughout the season. Because of the sod-forming habit, this species can withstand fairly heavy grazing and also serve as a valuable soil binder.



Figure 13. --Agrostis alba L. (Redtop)



Cane bluestem is a large robust bunchgrass, often up to 4 feet high, with coarse, usually straw-colored pithy stems. The nodes or joints of the stems are enlarged and hairy, and it is one of the few common range grasses with solid stems. The head is rather short (from 3 to 5 inches long), and composed of from 7 to 10 branches arranged in a somewhat fan shaped, silvery haired terminal cluster. The leaves are usually flat and rough, and frequently turn reddish on drying.

This species is important in the Southwest since it grows in relatively dry habitats. If supplemented by occasional flooding from heavy summer showers, this species can grow where the annual precipitation is 5 to 7 inches. It is highly drought resistant and is most common in the semidesert grassland, oak woodland, chaparral, and short-grass plains types.

Cane bluestem is considered fair to good forage while young. The mature herbage is fair forage for horses and cattle but is too coarse for sheep. Usually it is found as scattered plants or in small groups; seldom in dense, pure stands. It is a good indicator of proper grazing, since it is one of the first species to disappear when a range is excessively utilized.

Figure 14. --Andropogon barbinodis Lag. (Cane bluestem)

Silver bluestem, often called silver beardgrass, is similar in appearance and growth habits to cane bluestem (fig. 14). The two species are difficult to separate in the field. The head of the silver bluestem is longer, not so fan shaped, and the entire plant is slightly larger than the cane bluestem.

Distribution and forage values of both species are about the same. Silver bluestem may not be as drought resistant as cane bluestem.



Figure 15. --Andropogon saccharoides Swartz (Silver bluestem)



Big bluestem is usually a large, perennial bunchgrass, although short rhizomes are frequently present. In flower, it is usually about 3 to 4 feet tall, but may reach a height of 6 feet or more under favorable conditions. Usually the foliage is tinged with red or purple, and frequently has a mottled appearance. The leaves are numerous, from $\frac{1}{4}$ to $\frac{1}{2}$ inch wide, and sometimes covered with hairs.

The tall flowering stalks are stout, coarse, and solid. This grass has a coarse, deeply penetrating root system, in spite of its low drought resistance.

Big bluestem is palatable to all classes of livestock while young and tender, but it becomes coarse and tough later in the season; hence, it is grazed but little in the late fall. This species cures well and can be cut for hay for winter use by cattle and horses. The species, a good indicator of range condition, is most abundant on ranges in top condition.

Big bluestem is found in the oak woodland and short-grass types.

Sand bluestem (A. hallii Hack.), not shown, is a vigorous, broad-leaved, perennial, sod-forming grass which resembles big bluestem, from which it can be distinguished by its aggressive underground stems and by its shorter awns. It is adapted to sandy soils, where it grows most commonly.

Sand bluestem has about the same forage value as big bluestem, is palatable when young and tender, but is so tough and coarse at maturity that it is grazed very little. However, it matures well and can be utilized by cattle and horses in the winter.

This species is found on the short-grass plains where it is highly recommended for use to stabilize sandy "blow" soils against further erosion.

Figure 16. --Andropogon gerardii Vitman (Big bluestem)

Little bluestem is a tufted, leafy bunchgrass which is usually from 1 to 4 feet high. The stems have a tendency to be flattened; the leaf blades become bluish green to leathery or reddish brown at maturity. Several flower heads are borne on each stem, with each flower head having an individual long stalk. The seed heads are fuzzy and at maturity break apart easily. When growing in the drier habitats, this plant usually has a distinct bunch form, but on the moister sites in association with other grasses it shows sod-forming tendencies.

Little bluestem is fair to good forage while young and tender. After the heads mature and break up it makes fair forage for cattle and horses but is too coarse for sheep. It decreases under heavy grazing and is usually replaced by the grammas. Leafiness and a vigorous root system make little bluestem a good erosion-control plant.

Little bluestem is very widespread in the Southwest; it is found in the ponderosa pine, pinyon-juniper, oak woodland, and short-grass types.

Texas bluestem (*A. cirratus* Hack.), not shown, is similar in appearance as well as growth habits and environmental requirements to little bluestem. It is somewhat smaller, 12 to 28 inches high. No doubt Texas bluestem has a slightly higher palatability rating. It is found in the pinyon-juniper, chaparral, and oak woodland types.



Figure 17. --*Andropogon scoparius* Michx. (Little bluestem)



Arizona three-awn, one of the largest of the three-awns, grows from 1 to 2½ feet tall. It is a stout, erect, rather coarse bunchgrass with numerous sharp-pointed leaves which are up to 12 inches long. As the leaves become mature and start drying, many of them roll up spirally, which gives the grass a curly appearance. The flower head is narrow but open, up to 10 inches long, and is often purplish in color. The seed is hard and slender with a sharp pointed base covered with short, rather stiff hair.

Arizona three-awn is rated as fair to good forage while green. It may furnish succulent green forage in the spring although most herbage growth is made in the summer. After maturity, the awns and seeds may become troublesome to grazing animals, especially sheep. Generally it is a minor component of the composition; scattered plants are found on gravelly mesas and foothills. It is found primarily in the ponderosa pine and pinyon-juniper woodland types.

Other tall three-awns are found in the oak woodland, chaparral, semidesert grassland, and desert shrub types. They often furnish considerable forage, especially on spring ranges, before the heads mature. After maturity, the plants are not grazed because of the troublesome seeds. Some of the three-awns have two growing periods if moisture is available--one in the early spring, the other in the summer. In general, three-awns seed rapidly on disturbed areas and often indicate a deteriorated range.

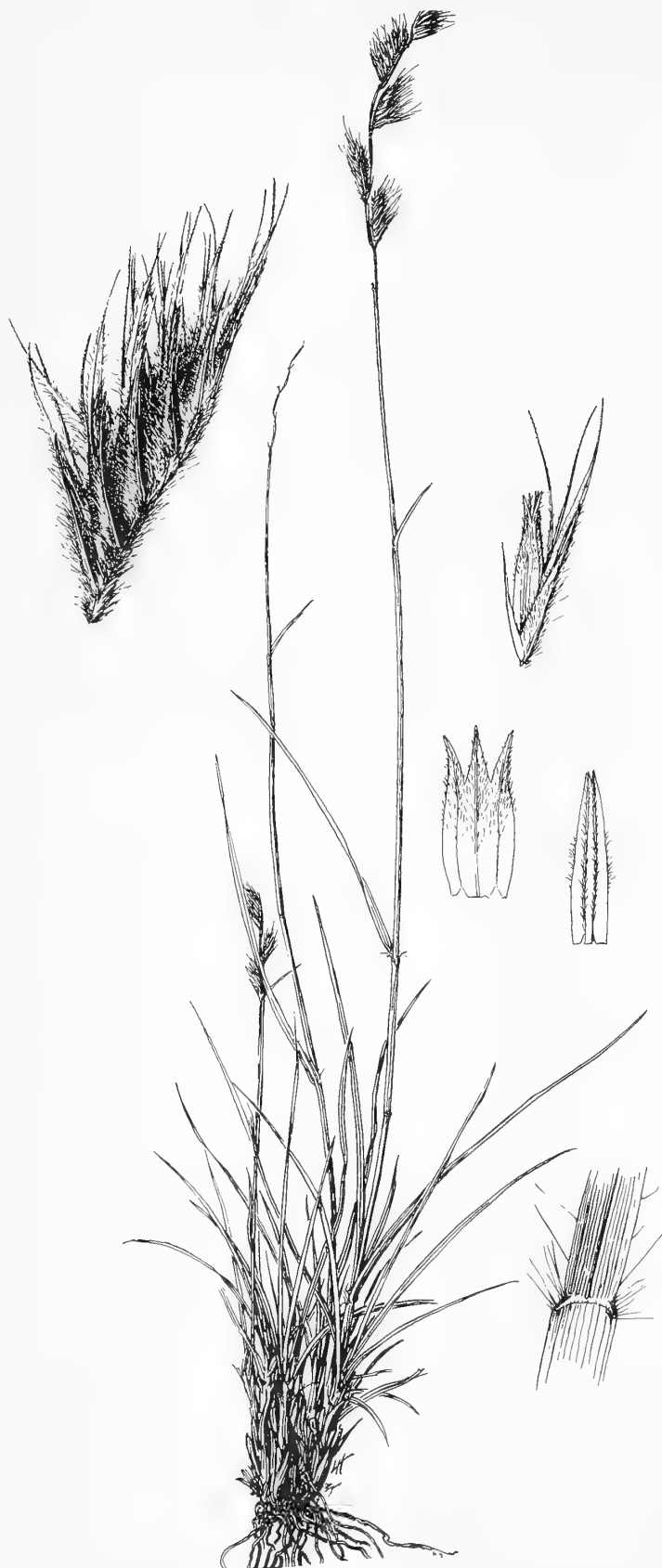
Figure 18. --Aristida arizonica Vasey (Arizona three-awn)

Pine dropseed, sometimes called beardless bunchgrass, is a slender, erect, densely tufted, perennial bunchgrass with deep, fibrous roots. The stems are often purplish in color, usually 10 to 30 inches high. The leaves are abundant, and sometimes attain a length of 8 inches. They are usually considerably shorter, however, and provide little herbage per plant. The flowering head is somewhat open and from 2 to 9 inches long.

When young and tender, palatability of pine dropseed is very good for all classes of livestock, but after the plants have matured, the stems are either neglected or only slightly grazed. The species should be a part of the composition of ranges in good condition. It is found in open parks and meadows in the subalpine zone and in open timber of the ponderosa pine and pinyon-juniper types, on moderately dry, rocky soils. It is usually a secondary species in association with mountain muhly, Junegrass, and bluegrasses.



Figure 19. --Blepharoneuron tricholepis (Torr.) Nash (Pine dropseed)



Sprucetop grama is an erect, mostly tufted perennial, usually about 15 to 18 inches high, but under the best growth conditions it may occasionally grow as high as 3 feet and almost form a turf. It has many slender, flat leaves, mostly basal. Lower stem leaves are usually 3 to 6 inches long while the upper ones are about 1 inch long. Stems have few leaves and are erect and smooth. Flower heads are composed of from 3 to 7 dense, woolly, flower groups up to $5/8$ inch long. Sprucetop grama reproduces by root-stocks as well as by seed.

Sprucetop grama is relished by all classes of livestock. It cures well on the ground, and is a valuable forage for late fall, winter, and spring. To obtain the maximum forage production it should be conservatively grazed during the period of rapid growth.

The species tends to increase under heavy grazing where it replaces the taller grasses such as side-oats and hairy grammas, Arizona cottontop (*Trichachne californica* (Benth.) Chase), plains lovegrass (*Eragrostis intermedia* Hitchc.), and tall three-awns. Sprucetop grama is drought resistant, and occupies dry rocky slopes and rolling hills in the oak woodland and semidesert grassland types.

Figure 20. --*Bouteloua chondrosioides* (H.B.K.) Benth. (Sprucetop grama)

Side-oats grama, known in some areas as tall grama, is an erect perennial grass. It is usually a bunchgrass (in spite of short, scaly rootstocks), which only occasionally forms a sod. Flower stalks seldom exceed 3 feet in height, and in most situations they usually are somewhat shorter. Commonly, the leaves are slightly less than $\frac{1}{4}$ inch wide, from 2 to 6 inches long, usually flat or slightly rolled, and hairy. The seed spikes are arranged bannerlike or flaglike on one side of the central stem--hence the term "side-oats."

Side-oats grama is a vigorous grower, and produces a considerable volume of herbage per plant. Abundance and palatability make it a valuable forage plant. It stays green and may be grazed for a longer period than species with which it is commonly associated. In palatability, it is considered from good to very good for all classes of livestock, and is relished especially while green. The stems are not too palatable when mature and may remain standing after the leafy foliage has been eaten. Like the other gramas the foliage cures well on the ground. On properly grazed ranges, this species will hold its own. Ranges in good condition should have a conspicuous amount of side-oats grama.

Side-oats grama is one of the most widely distributed grass species in the Southwest. It is found in the pinyon-juniper woodland, oak woodland, northern desert shrub, chaparral, short-grass plains, and semidesert grassland types. It makes its best growth on alluvial soils. Nevertheless, it is typically a grass of dry slopes, ridges, and rocky hillsides.



Figure 21. --*Bouteloua curtipendula* (Michx.) Torr. (Side-oats grama)



Black grama, also known in various localities as woollyfoot or crowfoot grama, is a tufted, long-lived perennial grass. It is usually from 1 to 2 feet tall, with crooked, slender, woolly stems, which are somewhat wiry, branched, creeping, and from 3 to 36 inches long. Normally the woolliness of the first two or three internodes is more noticeable than on the remainder of the stem. The joints of the stems are usually enlarged and the stems will frequently root at these swollen joints. The leaves are smooth, narrow, inrolled, and from 1 to 5 inches long. The seed head consists of from 3 to 8 narrow, flaglike spikes.

In addition to reproduction by runners (stolons) black grama spreads by tillering. It is a poor seed producer. Successful spreading by runners requires two successive favorable growing seasons--the first for the new plants to be produced, and the second for them to become rooted and firmly established.

Black grama is highly nutritious at all seasons of the year and is relished by all classes of livestock. It seems best suited, however, to grazing by cattle. Fully 90 percent of the growth is produced during the rainy season (usually July, August, and September).

Because it ordinarily cures well on the stalk and the stems remain green several inches up from the ground, black grama is well adapted to winter-spring grazing. Because of this, and the possibility of damage to tillers during the summer period, winter-spring grazing is most desirable.

Black grama is often a key indicator of general range utilization. When it is properly grazed, the associated plants and the range as a whole may be considered properly managed. The almost complete absence of flower stalks, uniform cropping closer than 2 inches above the ground, lack of spreading by runners, and grazing of more than half of the total herbage all indicate overutilization of black grama.

Black grama is widespread in the Southwest where it is one of the best forage plants. Although it is found in the pinyon-juniper woodland, oak woodland, chaparral, semidesert grassland, short-grass, and desert shrub types, it is most abundant in the semidesert grassland type. It is often abundant on ranges in good condition. In some areas it is the dominant grass while in others it is found mixed with a number of other species. Although comparatively drought resistant, black grama stands may decline markedly during prolonged drought periods.

Figure 22. --*Bouteloua eriopoda* Torr. (Black grama)

Slender grama resembles sprucetop grama, with which it is commonly associated, but it is distinguished from it by the absence of woolly hairs on the flower groups. It is about the same size, has the same range (found mainly in the oak woodland and semidesert grassland types), but is

slightly higher in palatability than spruce-top grama. The species is comparatively short lived and not highly drought resistant. It reproduces readily from seed and may become abundant on heavily grazed ranges during years of favorable rainfall.



Figure 23. --Bouteloua filiformis (Fourn.) Griffiths (Slender grama)



Blue grama is a sod-forming perennial grass with fine, curling, basal leaves of a grayish green color. The leaves are commonly 2 to 5 inches long and less than 1/8 inch wide. They have hairs at the junction of the leaf blade and stem, but the blade may be either hairy or smooth and relatively free from hairs.

The flowering stems are 6 to 36 inches (usually under 18 inches) in height, slender, and distinctly jointed. Each stem usually has two (although the number may vary from one to four), one-sided, purplish spikes extending at a sharp angle from the main stem. As maturity is reached, or when the plant is suffering from drought, the spikes become golden brown and tend to curve backwards.

Generally, blue grama is rated a choice forage species for all classes of livestock and it withstands grazing well. On ranges suitable for fall and winter grazing, it yields greatest returns if it is grazed lightly during the period of rapid growth and is allowed to mature a crop of seed. It is a fast summer-growing species which matures in about 60 to 70 days after the summer rains start.

Blue grama tends to increase under heavy grazing. Nearly pure stands of blue grama may develop in the pine and more moist portions of woodland types where grazing has been severe. These stands provide inadequate soil protection and produce very little herbage. Under these conditions blue grama is not the most desirable range plant.

Blue grama is one of the most widespread and abundant grasses in the Southwest; it is found in the ponderosa pine, pinyon-juniper woodland, northern desert shrub, oak woodland, chaparral, short-grass plains, and semidesert grassland types. On properly managed ranges, blue grama should be found in mixtures with such species as side-oats grama, little blue-stem, and western wheatgrass. Dominance of blue grama at higher elevations indicates a deteriorated condition; however, on short-grass ranges it is one of the principal forage species, and its abundance and vigor indicates satisfactory range condition.

Figure 24. --Bouteloua gracilis (H. B. K.) Lag. (Blue grama)

Hairy grama is similar in appearance to blue grama, but is distinguished from it by the coarse black hairs on the back of the spike and by the beaklike naked projection of the central axis of the spike. Hairy grama is a tufted, erect bunchgrass from 6 to 30 inches high. The leaves are flat and narrow, and are more numerous on the lower than on the upper part of the stems. There are normally 2 to 4 spikes per stalk, often purplish in color. In the northern part of its range, hairy grama usually has only one or two spikes per stalk and has short rootstocks which tend to form a sod.

Hairy grama has about the same palatability rating as blue grama. It withstands grazing well, but like most gramas, does better if grazed lightly during the summer growing season.

Hairy grama is found in the pinyon-juniper woodland, oak woodland, chaparral, short-grass plains, and semidesert grassland types. It grows well where soils are poor, but best on stable sandy loams. Pure stands of hairy grama are infrequent as it is usually mixed with other gramas, galleta, buffalograss, and other species. The species mixture forms a turflike cover on good-condition short-grass plains and semidesert grassland types as well as in open shrub stands.



Figure 25. --Bouteloua hirsuta Lag. (Hairy grama)



Rothrock grama, sometimes called crowfoot and mesa grama, is an erratic, relatively short-lived perennial, with a small root system, and commonly forms small tufts 1 to 3 inches in diameter. Although it resembles blue grama, it can be distinguished from it by its smaller size, its small bunches, and by its more numerous flower spikes per stem (commonly 4 to 6 but occasionally up to 12). Basal leaves are more prominent than those on the stems.

Although better forage than the annual gramas, it is the poorest of the perennial species of grama. Its palatability varies from fair to good only during the growing season. It does not cure well for late grazing, nor does it withstand heavy grazing. Occurrence is erratic. The plant decreases noticeably during continued drought but since it is a prolific seeder, it rapidly becomes established under favorable conditions. The species is prominent on deteriorated ranges at the lower elevations of the semidesert grassland. It is restricted to the semidesert grassland and desert shrub types.

Figure 26 --Bouteloua rothrockii Vasey (Rothrock grama)

The tall perennial bromegrasses (*Bromus* spp.) are usually moderately coarse-stemmed bunchgrasses from 1 to 4 feet tall. The leaves are normally rough, flat, and relatively broad. The seed heads are more or less open and spreading. Most species have deep, fibrous root systems which make them fairly resistant to drought and grazing.

Perennial bromes may produce a rather large amount of herbage which is relished by livestock during the growing season. At maturity the foliage becomes somewhat harsh and less palatable, especially for sheep. The seed heads are readily eaten, especially by horses and sheep. During the early spring, bromes are grazed eagerly by deer and elk. Several annual bromes are abundant in the pinyon-juniper woodland, chaparral, and other types at lower elevations.

Found largely in subalpine meadows and ponderosa pine types, perennial bromegrasses are minor components of most vegetation types. They occasionally form dense stands on subalpine meadows but are found only as scattered plants in timbered ranges characterized by Arizona and Thurber fescues and mountain muhly. They prefer rich, deep, moderately moist soil although they are found on poor, rather dry sites as well.



Figure 27. --*Bromus carinatus* Hook. & Arn. (Mountain brome)



Buffalograss is a native sod grass, from 2 to 12 inches high, with creeping surface runners which take root at the leafy joints. Growth habits are similar to those of curlymesquite. Male and female plants grow in separate patches. Female plants bear seed in clusters (resembling a bur) among the leaves. Male plants have two or three spiked, flaglike seed heads. The foliage turns reddish brown when frosted.

In thrifty condition this species makes a close, even, leafy turf, but on ranges in poor condition the runners are mostly leafless. Buffalograss produces a large amount of nutritious forage that is relished by all classes of livestock. It withstands grazing well, but can be killed by heavy overgrazing. It cures well on the ground, and provides winter and early spring forage.

Buffalograss is found in the short-grass plains where it is the most characteristic plant. It is not as common in the Southwest as in the more northern and eastern portions of the short-grass association. It is most often found on heavy soils. The name "buffalograss" comes from its great abundance in buffalo wallows of the plains.

Figure 28. --Buchloe dactyloides (Nutt.) Engelm. (Buffalograss)

Sedges (*Carex* spp.) are similar in many respects to grasses but can be distinguished from them by the usually three-sided, jointless solid stems. They may be either sod forming or tufted. The fruits of the sedges are usually capsules containing individual seeds.

Usually sedges are only minor components of the vegetal composition. Sod-forming types often decrease and tufted species increase during the early stages of range depletion.

Most sedges are relished by livestock and those sedges having rootstocks withstand close grazing. Elk are particularly fond of sedges. Deer graze the plants sparingly during the early spring. The sedges generally remain green longer than most range plants.

There are many species found on sites varying from the very wettest swamps to well-drained, dry slopes. Some species are tolerant of a timber overstory while others are not. Soils on which sedges grow are usually neutral or acidic. In the Southwest, sedges are most abundant in the subalpine meadow and ponderosa pine types but are also found in the pinyon-juniper woodland, oak woodland, chaparral, and short-grass plains.



Figure 29. --*Carex filifolia* Nutt. (Threadleaf sedge)



Timber danthonia, also commonly called timber oatgrass is a shallow-rooted, perennial grass that usually grows in well-defined tufts. Under some conditions the plants spread enough to form a turf. This grass usually produces an abundance of basal leaves. The stems are comparatively short, up to 20 inches tall, with a few short upper leaves and compact, one-sided heads. The young heads have a distinct purplish tinge; with age, the color turns to brown. Timber danthonia is found in the subalpine meadow and ponderosa pine types. At the higher elevations it is typically found in open, moist parks and meadows but toward the lower limits of its range is more common in the shade of open stands of timber.

Timber danthonia is regarded as good to very good forage for all classes of livestock. Apparently it withstands grazing well, since it is the dominant plant on depleted ranges; this however may indicate relatively low palatability. Plants are grazed by both deer and elk during the early spring months.

Figure 30. --Danthonia intermedia Vasey (Timber danthonia)

Tufted hairgrass is an erect, compact, perennial bunchgrass from 2 to 4 feet high. The leaves, growing from near the base of the plant, are bright green in color, and either flat, folded, or occasionally inrolled. They are coarse and rough. The flower head is open, mostly erect but sometimes drooping, and from 4 to 8 inches long.

Tufted hairgrass is usually relished by livestock and withstands fairly close grazing. Under the most favorable growing conditions, it sometimes becomes so rank and coarse that sheep especially, and to some extent cattle, will graze it only lightly.

It grows on moist open sites of the sub-alpine meadow and ponderosa pine types, sometimes in nearly pure stands which may form almost a solid ground cover. Where site conditions are less favorable or where grazing use has been too heavy, it may be found in mixture with a variety of other grasses, sedges, and forbs.



Figure 31. --Deschampsia caespitosa (L.) Beauv. (Tufted hairgrass)



Canada wildrye is a stout, perennial grass from 3 to 5 feet tall. The leaves are from 4 to 10 inches long and are rough, especially along the margins. The flowering head is a spike, thick, bristly, and nodding while the individual seeds comprising the head are tipped by beards or awns.

Canada wildrye is usually considered fairly palatable while young for all classes of

livestock. As it reaches maturity, it becomes coarse and harsh and is much less palatable.

Although it is found in the ponderosa pine, pinyon-juniper woodland, chaparral, and short-grass plains types it is rarely abundant. It grows best in moist canyon bottoms, open ground, and sandy soil.

Figure 32. --Elymus canadensis L. (Canada wildrye)



Plains lovegrass is an erect, tufted perennial from 16 to 36 inches tall. The leaves are flat, 4 to 6 inches long, and less than 1/2 inch wide. The seed head is erect, open, from 6 to 14 inches long, and at maturity it is about half as wide as long.

Plains lovegrass is found rather widely; it grows in the oak woodland, chaparral,

short-grass plains, and semidesert grassland types. It affords from fair to good forage for all livestock while green and succulent. If sufficient soil moisture is available plants commence growth early in the spring; thus they furnish a much needed early source of protein. The species is usually present on well-managed ranges along with species such as side-oats grama, bullgrass (Muhlenbergia emersleyi Vasey), and other grasses.

Figure 33. --Eragrostis intermedia Hitchc. (Plains lovegrass)

Arizona fescue is a dense, tufted, perennial bunchgrass, from 6 to 36 inches high, and with the slender stems curved at the base. The leaves are mostly basal, numerous, from 6 to 12 inches long, rough, stiff, slender, inrolled, and appear almost round. The flower head is narrow and from 3 to 5 inches long, with alternate, rough, erect branches. The entire dense clump is anchored to the ground by a mass of fibrous roots.

Although not as palatable as many other range grasses, Arizona fescue is important because of its abundance. It is taken by all classes of livestock, but it is grazed more readily by cattle and horses than by sheep. It cannot withstand heavy grazing, but due to its heavy root system, it can stand drought and is an excellent soil binder. This species disappears rather quickly under close grazing and is thus a sensitive indicator of proper grazing management.

Arizona fescue is found in the ponderosa pine and subalpine meadow types where it and mountain muhly often are the dominant grasses on ranges in good condition. On ranges in good condition plants are vigorous and large.



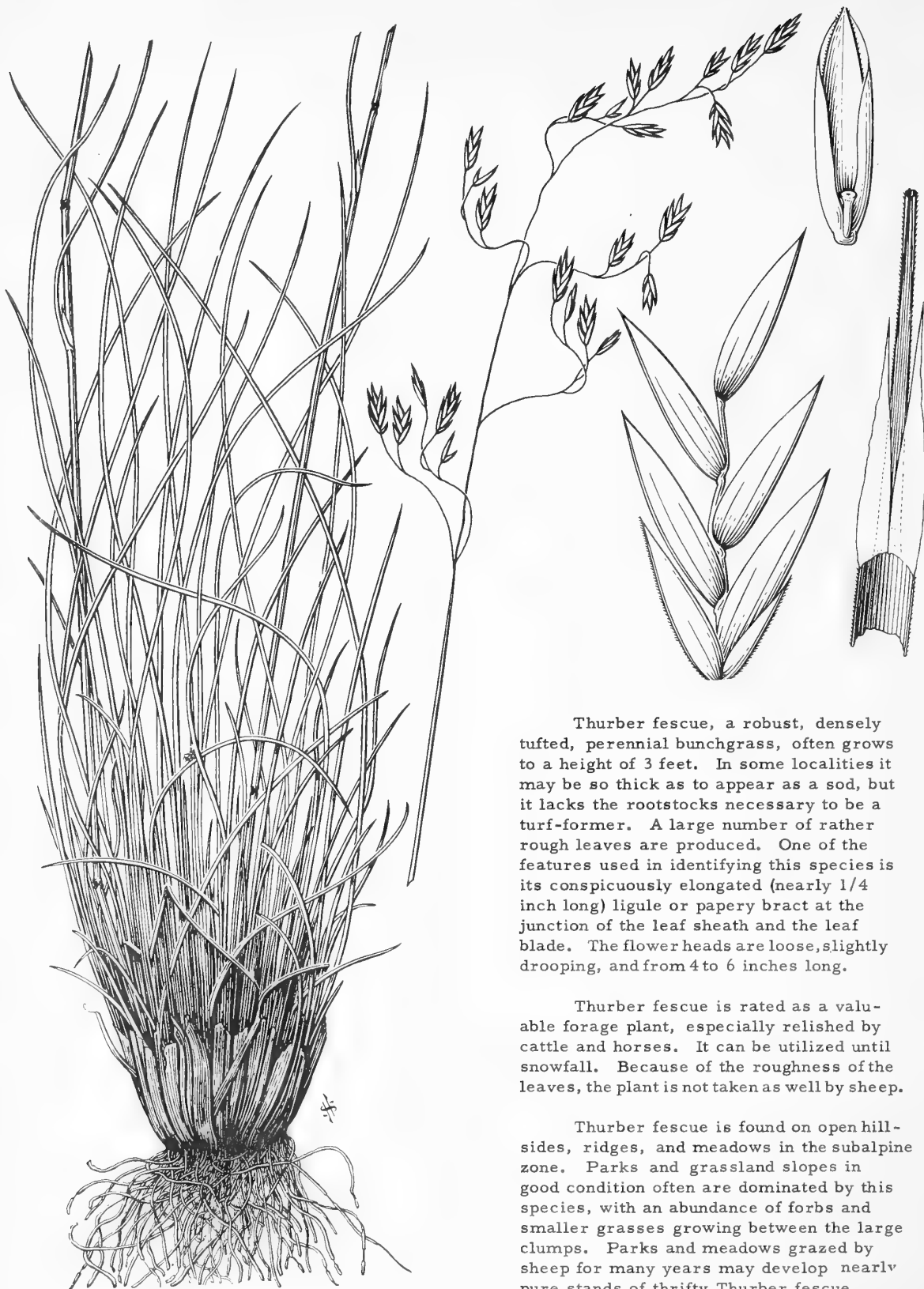
Figure 34. --Festuca arizonica Vasey (Arizona fescue)

Sheep fescue is normally from 7 to 16 inches high, but may occasionally become 2 feet tall. The numerous leaves are mostly basal, fine, inrolled, and bluish green when fresh. The dried or dead leaves from former years tend to persist and with the current year's growth form a characteristic compact tuft from 2 to 7 inches high. Reproduction is only by seed, although some vegetative enlargement of the clump occurs from tillering.

Sheep fescue is found in subalpine meadows where it is a valuable forage grass for all classes of livestock. Excessive grazing thins out the stand. Ranges in good condition should contain an abundance of this species along with such species as prairie Junegrass (Koeleria cristata (L.) Pers.), subalpine needlegrass (Stipa columbiana Macoun) and spike trisetum (Trisetum spicatum (L.) Richt.)



Figure 35. --Festuca ovina L. (Sheep fescue)

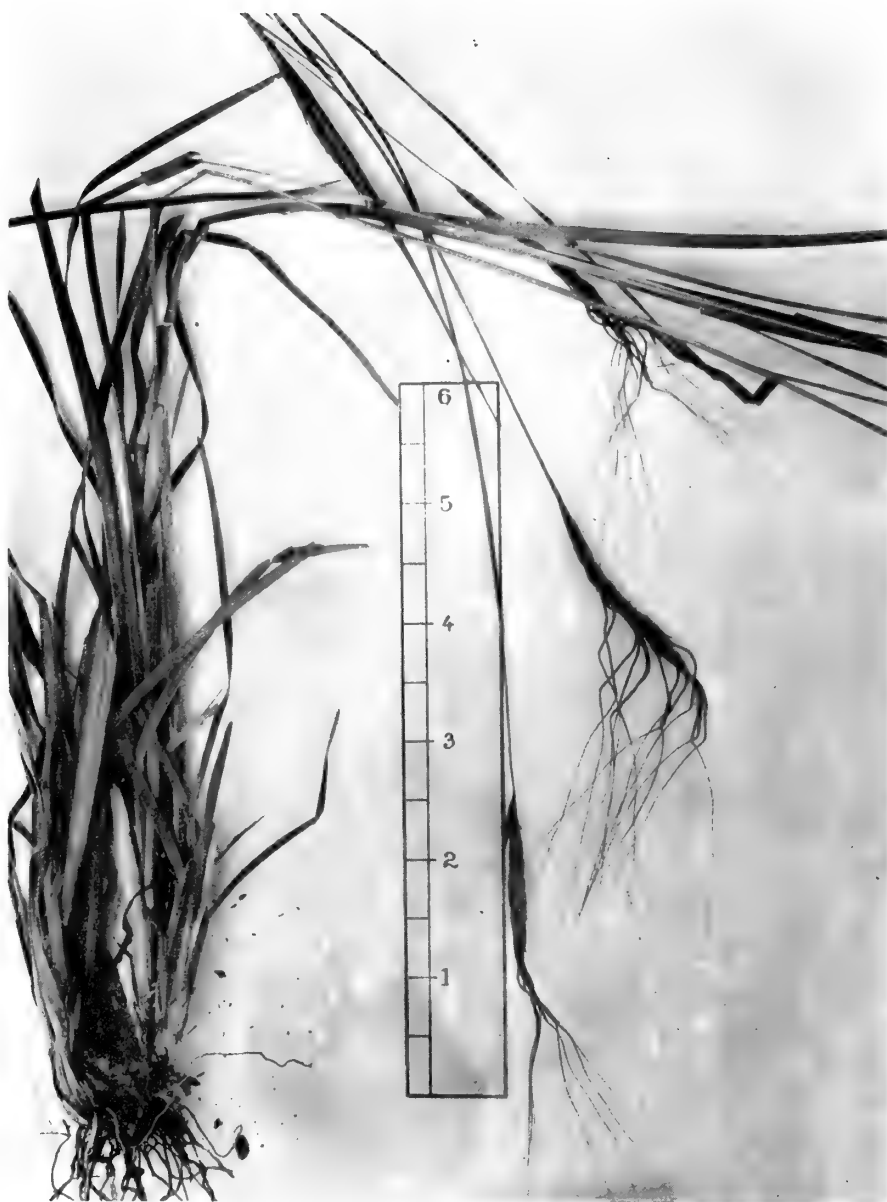


Thurber fescue, a robust, densely tufted, perennial bunchgrass, often grows to a height of 3 feet. In some localities it may be so thick as to appear as a sod, but it lacks the rootstocks necessary to be a turf-former. A large number of rather rough leaves are produced. One of the features used in identifying this species is its conspicuously elongated (nearly 1/4 inch long) ligule or papery bract at the junction of the leaf sheath and the leaf blade. The flower heads are loose, slightly drooping, and from 4 to 6 inches long.

Thurber fescue is rated as a valuable forage plant, especially relished by cattle and horses. It can be utilized until snowfall. Because of the roughness of the leaves, the plant is not taken as well by sheep.

Thurber fescue is found on open hill-sides, ridges, and meadows in the subalpine zone. Parks and grassland slopes in good condition often are dominated by this species, with an abundance of forbs and smaller grasses growing between the large clumps. Parks and meadows grazed by sheep for many years may develop nearly pure stands of thrifty Thurber fescue.

Figure 36. -- Festuca thurberi Vasey (Thurber fescue)



Tanglehead is a tufted, erect perennial grass from 1 to 3½ feet high. The leaves are flat or folded, with folded, overlapping sheaths (that part of the leaf which clasps the stem). At maturity, the foliage turns reddish brown, the stems become straw yellow in color, and have a molasseslike flavor. As the seed head begins to mature, the long awns (2 to 4 inches in length) twist together in such a manner as to resemble a braid.

Tanglehead is found in the pinyon-juniper woodland, oak woodland, chaparral, and semidesert grassland types where it is considered from fair to good forage for all classes of livestock, before maturity is reached. If moisture is available, plants remain green into late fall and furnish a good supply of succulent forage. However, the awns are troublesome when mature, especially to sheep.

Figure 37. --Heteropogon contortus (L.) Beauv. (Tanglehead)



Curlymesquite is a perennial grass from 4 to 10 inches tall, with numerous, narrow, curly, rather rigid leaves, usually 2 to 4 inches long. The stems and runners (stolons) are hairy at the nodes. The runners are long, wiry, rough to the touch, and produce a close, firm sod on favorable soil. The flower-head is spikelike in appearance, rather loosely flowered, and 1 to 2 inches long. When the seeds drop from the head, the zigzag stem of the seed head is conspicuous. From a distance, patches of curlymesquite can be identified by their light green color.

Curlymesquite is found primarily in the pinyon-juniper woodland, oak woodland, chaparral, and semidesert grassland types where it is highly esteemed for forage. It is one of the first plants to start spring growth, responds readily to summer rains, and produces a fair amount of forage despite its small size. It cures well on the ground and is highly palatable to all classes of livestock. Curlymesquite is quite drought resistant, and withstands close grazing. However, its production varies greatly from year to year. In this respect it is a less dependable forage producer than other grasses that usually will grow on the same site. Although rather an aggressive species, it should be protected during its period of growth for best results. This species increases under heavy grazing and an increase of it is a good indicator of a deteriorating trend in range conditions. It is an excellent soil binder.

Figure 38. --*Hilaria belangeri* (Steud.) Nash (Curlymesquite)

Galleta is a perennial grass, normally from 12 to 20 inches tall with the stalks conspicuously hairy at the joints. The wiry leaves are mostly basal, rarely as much as 6 inches long, rigid, harsh, and bluish in color. The flower heads have a fine, hairy, chaffy appearance, often purplish in color at first but fade to almost white at maturity, are erect, and up to $3\frac{1}{2}$ inches long. Although *galleta* has strong, scaly rootstocks, it usually grows in bunches, and it is only under the most favorable conditions that these bunches grow sufficiently close together to approximate a sod.

Galleta is found in the pinyon-juniper woodland, northern desert shrub, short-grass plains, and semi-desert grassland types. It affords from fair to good grazing for all classes of stock during the summer growing season. Unless green and succulent, its palatability is low or negligible. Continuous grazing closer than 4 inches stubble height will kill out *galleta* in a few years. It thrives best on rather heavy soils of the flood flats and is an excellent erosion-control plant.



Figure 39. --*Hilaria jamesii* (Torr.) Benth. (*Galleta*)



Tobosa is from 1 to 2 feet tall (sometimes 3 feet), with smooth stems, frequently fine-hairy at the joints. The leaves, up to 6 inches long, are stiff, harsh, and hairless. The flower heads are erect, symmetrical, $1\frac{1}{2}$ to 3 inches long, broad and white (straw colored or occasionally purplish). The strong rootstocks, although slow in spreading, provide the surest means of reproduction.

Tobosa is quite palatable when green and succulent, especially for cattle. It withstands grazing well during the summer rainy season when its main growth occurs. About 40 percent of its total herbage should remain at the end of the grazing season. When growth is completed tobosa becomes harsh and is not grazed readily.

Tobosa is restricted to the semi-desert grassland and desert shrub types. It occupies sites that receive some surface runoff, where it may form dense stands. Because it occupies sites where runoff accumulates, tobosa does not fluctuate as widely due to weather as grasses on adjacent range areas. However, under prolonged drought and too heavy grazing tobosa will be reduced in density and vigor.

Figure 40. --*Hilaria mutica* (Buckl.) Benth. (Tobosa)

The rushes (Juncus spp.) are grasslike, usually perennial plants which occur chiefly in swamps, meadows, or other moist locations. The stems are typically unbranched, smooth, dark green, round, soft and pithy inside. The unjointed stems make rushes easily distinguished from the grasses. The leaves, when present, are basal. The height of the rushes is usually under 3 feet. Many species have stout, perennial rootstocks.

In general, the palatability of the rushes is from fair to good for cattle and sheep, especially in the spring. As the plants mature, the stems become tough, and palatability decreases. The rushes withstand grazing well; their utilization depends somewhat on the amount present on a given range and the availability of other types of forage.

Rushes grow under a variety of environmental conditions but generally prefer moist, deep, organic soils in association with various sedges, bluegrasses, and willows. In the Southwest they are found most commonly in the subalpine meadow and ponderosa pine types. Occasionally rushes may be locally abundant and have appreciable forage value. Rushes are among the last plants to disappear on overstocked and eroded areas. They often form nearly pure stands on overgrazed meadows.



Figure 41. --Juncus balticus Willd. (Baltic rush)



Prairie Junegrass is a slender, tufted, erect perennial bunchgrass from 1 to 2½ feet high. The leaves are primarily basal, numerous, rather narrow, flat, with inrolled edges and from 1½ to 5 inches long. The flowering head is narrow and spikelike, tapered at both ends, and 1 to 7 inches long. The roots are fibrous.

Prairie Junegrass is one of our most widely distributed grasses. In the Southwest it is found in the subalpine meadow, ponderosa pine, pinyon-juniper woodland, oak woodland, northern desert shrub, chaparral, and short-grass types. It is considered fairly good to good forage and is relished early in the season by all classes of livestock. Sheep do not seem to graze it to any extent after it matures. Deer and elk take considerable amounts of this species during the early spring. It matures relatively early, which probably explains why it is able to withstand considerable grazing. It seldom occurs in pure stands but is sparsely mixed in with other species. Ranges in good condition contain conspicuous amounts of Junegrass.

Figure 42. --*Koeleria cristata* (L.) Pers. (Prairie Junegrass)

Green sprangle-top is a tall, erect perennial grass with wiry stems from 20 to 40 inches high. The leaves are generally flat, although sometimes folded, and from $1/4$ to $1/2$ inch wide. The head is about 6 inches long and somewhat spreading.

Green sprangle-top is found in the oak woodland, chaparral, and semidesert grassland types. It affords good grazing to all classes of livestock, and is especially relished while green and succulent. This is one of the first species to disappear on heavily grazed ranges. Its presence in abundance is a good indicator of a range in good condition.



Figure 43. -- Leptochloa dubia (H. B. K.) Nees (Green sprangletop)



Wolftail, also called Texas-timothy, is a grayish-green perennial bunchgrass receiving its names from the timothylike head, which resembles, in general, the appearance of the tail of a wolf. The plant is from 12 to 18 inches high; the stalks are slender, densely tufted, somewhat spreading at the base, and bent at the joints. The flower head is spikelike, narrow, and commonly 2 to 4 inches high.

Wolftail is usually found interspersed with other grasses in the pinyon-juniper woodland, oak woodland, chaparral, and semidesert grassland types. It seldom grows in pure stands but it is considered a good to very good forage grass. Its main growing season coincides with the summer rains. The foliage cures well, and the semiperennial stems green up quickly and produce new growth early in the spring when palatability is highest. Wolftail disappears quickly under heavy grazing.

Figure 44. --Lycurus phleoides H. B. K. (Wolftail)

Bullgrass (*Muhlenbergia emersleyi* Vasey), not shown, is a large, coarse bunchgrass, often 3 to 4 feet high with a rather loose, erect or nodding head, from 8 to 16 inches long. The leaves are up to 20 inches in length. It is found in the ponderosa pine, pinyon-juniper woodland, chaparral, and oak woodland types.

Bullgrass is seldom abundant on the range. Vigorous clumps of bullgrass are found on ranges in good condition. Clumps may show distinct trampling and pedestaling effects on ranges in unsatisfactory condition.

Mountain muhly is a bright green, perennial grass growing in dense bunches, commonly 4 to 12 inches in diameter and up to 24 inches high. The leaves are mostly basal, narrow, rather rigid, in-rolled, sharp pointed, with broad sheaths at the base. The flower head is narrow, spikelike, loose, and somewhat one-sided. The roots are fibrous, and the plants tend to stool out from the base or crown to form large clumps; hence they are well adapted to withstand grazing.

In general the palatability of mountain muhly is fairly good, but it is grazed chiefly while the foliage is young and succulent. The leaves become less tender at maturity and are not relished as much as other species. If grazed closely, it retains a fairly high palatability throughout the growing season. This species, together with Arizona fescue, makes up the greater proportion of the forage on ponderosa pine ranges in good condition. It also may be found in the pinyon-juniper type.

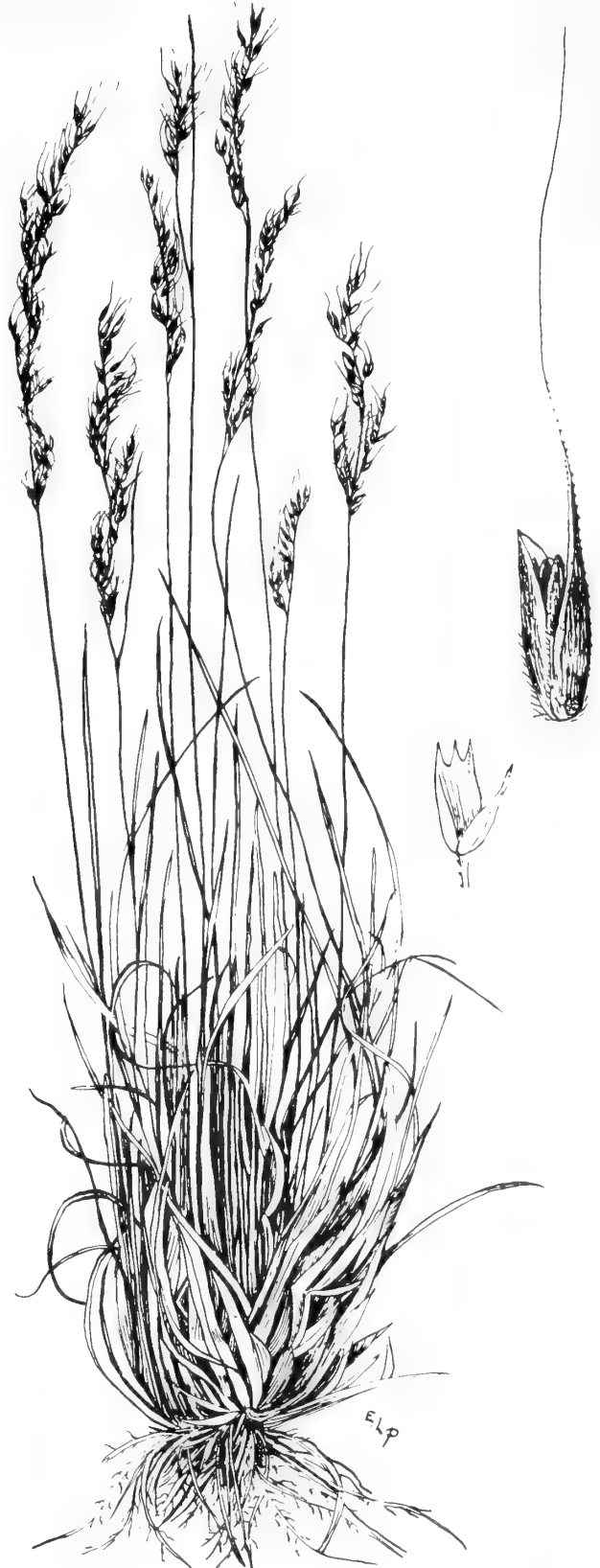
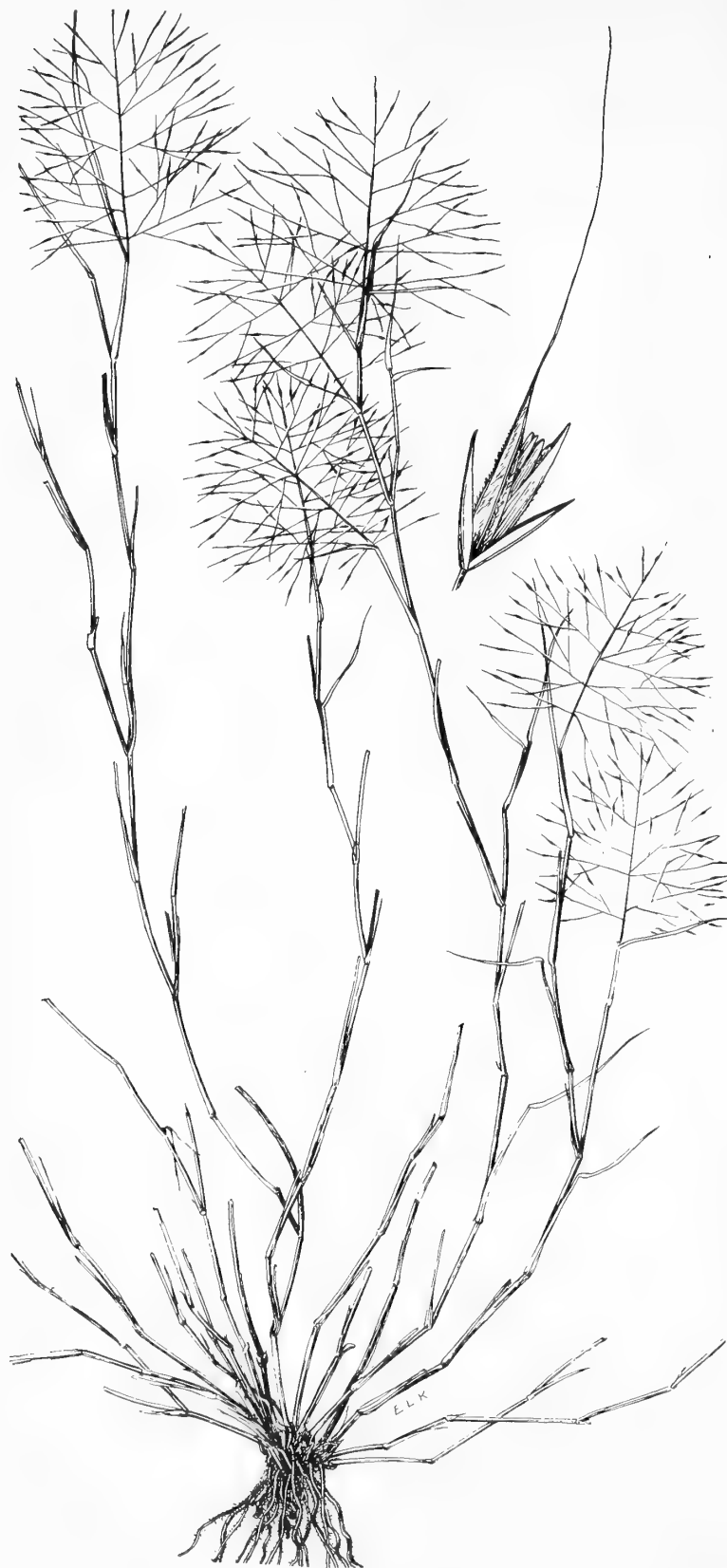


Figure 45. --*Muhlenbergia montana* (Nutt.) Hitchc. (Mountain muhly)



Bush muhly is a perennial bunchgrass with many weak, much branched, leafy stems. When ungrazed, it sometimes forms a tangled, leafy mass (often resembling a bird's nest) 1 to 3 feet high and $1\frac{1}{2}$ to 3 feet in diameter, with the lower parts of the slender stems resting on the ground. The stems do not die back to the crown during the winter, and new spring growth starts from near the base of the previous year's stems. The stems are often bent at the joints, knotty at the base, and support a fine, much branched, usually loosely drooping, purplish to white flower head, 2 to 4 inches long.

Bush muhly is highly palatable to all classes of livestock. It remains green most of the year (yearlong if sufficient moisture is available), which makes it especially palatable in the winter, and before the summer rains start. It is easily killed out by heavy grazing because plants cannot be grazed continuously to a stubble height closer than 4 inches without damage. The species grows abundantly at the lower elevations on semidesert grassland ranges in good condition. It is also found in the desert shrub type.

Figure 46. --Muhlenbergia porteri Scribn. (Bush muhly)

Spike muhly (also variously known as "timothylike muhly," Wright muhly, black muhly, black timothy, wild timothy, and deergrass) is a tufted perennial grass up to 30 inches high. The stems are somewhat spreading at the base, leafy, somewhat flattened, and smooth. The leaves are narrow (less than 1/8 inch wide) up to 4 inches long, slightly rough to the touch, while the sheath is often purplish in color near the point of attachment to the stalk. The head is narrow (spikelike), lead colored, somewhat blunt at the tips, sometimes densely flowered, about 3/8 inch wide, and 4 inches long.

Spike muhly is relished by all classes of livestock and often produces a large amount of forage. It is found in the ponderosa pine, pinyon-juniper woodland, and oak woodland types where it is most abundant on ranges in good condition.



Figure 47. -- Muhlenbergia wrightii Vasey (Spike muhly)



Indian ricegrass is a tufted perennial with rigid, erect stems 1 to 2 feet high. The leaves are numerous, slender, long, flat or inrolled, stiff, and somewhat harsh to the touch. The flower head is loose, 6 to 12 inches long, and well branched, with each branchlet supporting an oval, bearded, almost black "seed" at the end. This is one of the most drought enduring of the native range grasses and characteristically grows on dry, sandy soils.

Indian ricegrass, which begins growth early in the spring, provides a nutritious early feed. Even in the winter it is highly palatable to livestock, for the foliage cures exceptionally well. This species should be fairly abundant on sandy soils on northern desert shrub ranges in good condition.

Indian ricegrass is found in the pinyon-juniper woodland and northern desert shrub types. It is also common on the semidesert grassland type in central New Mexico.

Figure 48. --Oryzopsis hymenoides (Roem. & Schult.) Ricker (Indian ricegrass)

Vine-mesquite is a perennial grass, from 1 to 2 feet tall, that produces long, tough stolons with swollen, woolly joints. The stem joints are slick. The flower head is usually partially enclosed in the upper leaf sheath and consists of a few one-sided, spikelike, densely flowered racemes; the seed turns from green to brown at maturity. This species is best adapted to heavy soils in swales and gullies.

Vine-mesquite is rather widespread; it is found in the pinyon-juniper, oak woodland, short-grass plains, and semidesert grassland types. While it is usually rated low in palatability, the upright stems with fruiting heads are quite readily taken by all classes of livestock. Vine-mesquite is a valuable erosion-control plant.



Figure 49. --Panicum obtusum H. B. K. (Vine-mesquite)



Figure 50. --Poa fendleriana (Steud.) Vasey (Mutton bluegrass)

Mutton bluegrass, also called muttongrass, is a perennial bunchgrass from 1 to 2 feet high. The bunches vary in size from small tufts composed of a few stalks to dense clumps a foot or more in diameter. The leaves are mostly basal, pale, bluish green in color, 2 to 12 inches long, stiff, often tightly folded, and rough on the underside. The seed heads are from 1 to 4 inches long, narrow, oblong, erect, and densely flowered. This species is unusual in that the male and female parts are commonly borne on separate plants.

Mutton bluegrass is widely distributed; it is found in the ponderosa pine, pinyon-juniper woodland, northern desert shrub, and chaparral types. It is rated as excellent forage for cattle and horses, good for sheep, especially in the spring. Deer and elk take considerable amounts of this species during the early spring. Since mutton bluegrass starts growth during the warm days of late winter and early spring, it is ready for grazing in advance of most other range forage plants. It is most abundant on ranges in good condition.

Longtongue bluegrass (Poa longiligula Scribn. and Williams), not shown, very closely resembles P. fendleriana; the difference is its long conspicuous ligule. The lower elevational range is the same for both species; the upper range is about 7,500 feet for longtongue bluegrass and 9,000 feet for mutton bluegrass. Longtongue bluegrass is found mainly in the chaparral, oak woodland, and pinyon-juniper woodland types.

Kentucky bluegrass is a dark green, perennial, sod-forming grass with smooth, soft, shiny leaves 2 to 7 inches long, characterized by a boat-shaped tip. The stems are 1 to 2 feet high and usually numerous in a tuft. The seed head is a pyramid-shaped panicle, about 2 to 8 inches long. The branches of the panicle are commonly spreading and whorled in groups of 3 to 5. The root system is extensive and finely branched. The mixture of roots and rhizomes in the upper 2 inches of soil under an old stand of this grass forms an extremely dense, resistant sod.

Kentucky bluegrass is highly palatable to all classes of livestock. It is not a native of the United States, but was introduced from Europe. It has become widespread, however, and is quick to take over deteriorated meadows where it is valued as a soil stabilizer. In the Southwest it is found mostly in the subalpine meadow and ponderosa pine types. Although it is very palatable when green and succulent, it often dries early and makes only short growth under southwestern conditions. For this reason it is not as highly regarded as a forage plant as many of the other grasses.



Figure 51. --Poa pratensis L. (Kentucky bluegrass)

Plains bristlegrass is a densely tufted perennial usually pale green to blue green in color, and from about 15 to 45 inches high. The leaves are flat or folded, rough on the upper surface, from 1/8 to 1/2 inch wide and from 6 to 12 inches long. The seed head is a spikelike panicle from 4 to 10 inches high.

Plains bristlegrass is found in the chaparral, semidesert grassland, desert shrub, and short-grass plains types. It is highly palatable to all classes of livestock.



Figure 52. --Setaria macrostachya H. B. K. (Plains bristlegrass)

Bottlebrush

squirreltail is an erect, bright green, bristly headed perennial bunch-grass, up to 24 inches high. The stems are tufted and slender; the leaves are narrow, flat, or occasionally inrolled, rather stiff, and somewhat harsh on the upper side. The flower head is a spike, up to 8 inches long, often partly enclosed in the upper sheath, and bearing many bristly awns that turn out when dry. The flowerheads break up at the joints when the heads are dry.

The palatability of bottlebrush squirreltail varies according to the location and season of the year. In general, it is fair to fairly good for cattle and fair for sheep in the spring and early summer before the heads develop. Deer and elk graze it during the early spring. It tends to "green up" in the fall if rains come, and is grazed again if the heads have fallen. This species reaches its greatest abundance on deteriorated ranges where there is considerable soil disturbance. It is found widely in the subalpine meadow, ponderosa pine, pinyon-juniper woodland, northern desert shrub, oak woodland, chaparral, and short-grass plains types.



Figure 53. --Sitanion hystrix (Nutt.) J. G. Smith (Bottlebrush squirreltail)



Alkali sacaton is a densely tufted, long-lived native bunchgrass up to 3 feet tall. The seed stalks are erect, smooth, solid, leafy, and spreading at the base. The dense bunches commonly grow up to 12 inches in diameter. The basal leaves are abundant up to 18 inches long, $\frac{1}{8}$ to $\frac{1}{4}$ inch wide at the base, tapering to long, slender, inrolled points. The leaf blades are smooth beneath, but rough above. The seed head is much branched, spreading and pyramidal in shape. This grass is commonly found on moist alkaline soils.

Alkali sacaton produces much forage, which is taken freely by cattle and horses during the growing season. As the plants mature, however, the foliage becomes tough, coarse, and unpalatable, and does not mature into nutritious winter feed.

Alkali sacaton is a widely distributed grass; it is found in the northern desert shrub, short-grass plains, and semidesert grassland types. Its most common habitat is the lower, slightly moist, alkaline flats where it develops in almost pure stands. On the more favorable sites when not overgrazed it may sometimes form a uniform cover approaching a sod. Where it grows only as scattered plants, associated grasses will be overused if full use is made of alkali sacaton.

Figure 54. --*Sporobolus airoides* Torr. (Alkali sacaton)

Sand dropseed is an erect, tufted perennial from $1\frac{1}{2}$ to $3\frac{1}{2}$ feet tall. The stems are leafy, solid, and often spreading at the base. The uppermost leaf sheath partially, or often almost entirely, encloses the seed head. That portion of the head not enclosed is somewhat spreading and open, but is usually rather narrow. The color of the head varies from lead gray to purplish.

Sand dropseed is found in the ponderosa pine, pinyon-juniper woodland, northern desert shrub, oak woodland, chaparral, short-grass plains, and semidesert grassland types. It produces a fairly large amount of forage which is palatable to all classes of livestock but care is necessary to avoid destroying the stand by overgrazing. The foliage cures well and furnishes winter feed. This plant is a prolific seeder and when protected or grazed properly tends to increase on depleted range. Following drought it is one of the first perennial grasses to become established.



Figure 55. --Sporobolus cryptandrus (Torr.) A. Gray (Sand dropseed)

Black dropseed is a densely tufted perennial from 1 to 2½ feet tall. The stalks are unbranched, solid and support a dark-colored, narrow flower head from 4 to 7 inches long. The leaves are flat or folded, somewhat rigid, and usually less than one-half the length of the stalk. The sheaths are soft-hairy at the throat.

Black dropseed is an important plant in parts of the ponderosa pine type. It is palatable to all classes of livestock and is considered one of the best forage grasses of the Southwest. It is considered a key species on ranges where it is sufficiently abundant to be of major importance. Black dropseed is often abundant on ranges in good condition.



Figure 56. --*Sporobolus interruptus* Vasey (Black dropseed)

Subalpine needlegrass, also called Columbia needlegrass, is a perennial bunchgrass, varying in size from a few inches up to about 3 feet in height. The flower heads are narrow, and form loose panicles up to 8 inches long which are often purplish in color. The awn (beard) is twisted and bent twice and is up to $1\frac{1}{2}$ inches in length (sometimes longer). The leaf blades are either flat or inrolled, while the leaf sheaths are open and hairless. The ligule, formed at the junction of the blade and sheath, is short.

Subalpine needlegrass is found primarily in the ponderosa pine and subalpine meadow types where it rarely forms dense stands. Although its palatability varies from fair to good, it is usually considered good forage for all classes of livestock. The foliage normally remains green throughout the growing season, but it is especially palatable in the spring and early summer. Since it is frequently associated with less palatable species, it is sometimes grazed so heavily that it is killed out.



Figure 57. --Stipa columbiana Macoun (Subalpine needlegrass)

New-Mexican feathergrass (*Stipa neomexicana* (Thurb.) Scribn.), not shown, also called New Mexico needlegrass and porcupine grass, is a tufted perennial from 16 to 36 inches high. The leaf sheath is blue green in color and is covered with minute hairs, while the blade is rolled and from 4 to 12 inches long. The seed has a long (up to 5 inches) feathery beard (awn) attached. (This feathery beard is one of the features to distinguish it from needle-and-thread.)

New-Mexican feathergrass is found in the pinyon-juniper woodland, chaparral, and the short-grass plains types where it provides fair to good forage for all classes of livestock, especially when plants are lush and growing. Sometimes the mature seed may cause annoyance to animals. Although it does not reproduce readily on the drier ranges and is rather easily killed out by overuse in more favorable areas, it usually reproduces very well and satisfactorily withstands heavy grazing in spring and fall if the plants are allowed to mature seed during the summer.

Needle-and-thread is an erect, tufted perennial bunchgrass that grows from 1 to 4 feet high. An individual plant produces relatively few stems. The leaf blades are usually less than 1/8 inch wide, are 8 to 12 inches long, and rough on the upper surface. The tips of the leaves frequently die or dry back for a distance of about an inch. The ligule is membranous and prominent. The seed head is a panicle, rather narrow, and often partly enclosed in the uppermost sheath. Each seed is tipped by a prominent, somewhat bent, long (4 inches or more), twisted, flexible awn. The seeds are shed soon after maturity. This species is named because of the similarity of the sharp-pointed seed and awn to the appearance of a threaded needle.

Needle-and-thread is widespread over western rangelands. In the Southwest, it is common on the ponderosa pine, pinyon-juniper woodland, northern desert shrub, and short-grass plains types. It is a valuable forage plant because it begins growth early in the spring. It is most palatable before the awns appear and again after the seeds are dropped. If grazed when the seeds are mature and before they are dropped, the seeds may be mechanically injurious to the animals.

Figure 58. --*Stipa comata* Trin. & Rupr. (Needle-and-thread)

Arizona cottontop is a perennial grass with slender, erect stems, from 12 to 40 inches high. Plants are tufted, usually branched below, and arise from woolly, knotted, enlarged bases. The leaves are normally from 3 to 5 (sometimes up to 10) inches long, with the upper leaves shorter than the lower ones. Perhaps the outstanding character of this grass is the slender, silky-cottony seed head with its lance-shaped spikelets which grow in pairs and are covered with long, silky, white (occasionally purplish) hairs.

Arizona cottontop is found in the oak woodland, chaparral, and the semi-desert grassland types. The grass is quick to respond to summer rains and plants grow rapidly. Thus although scattered, it provides a fairly large amount of green forage early in the season. Its palatability decreases rapidly as maturity is reached. It is one of several long-lived perennial grasses that are abundant on ranges in good condition.



Figure 59. --Trichachne californica (Benth.) Chase (Arizona cottontop)



Figure 60. --*Agoseris glauca* (Pursh) D. Dietr. (Pale agoseris)

Agoseris spp.

often called mountain-dandelions, are milky-juiced perennial plants, 4 to 8 inches high, which look much like the common dandelions. The leaves are basal, lance-shaped, either smooth-edged or lobed, from $1/4$ to $1-1/4$ inches wide, hairless and covered with a waxy bloom. The flower is borne on the end of a naked stalk; it is usually yellow in color at first but often turns rose or purple with age. When the seed head is mature, the individual seed is crowned with a cluster of whitish persistent bristles. The root is a thickened perennial taproot with a somewhat branched root crown.

Although species of *agoseris* are utilized primarily by sheep, cattle also graze them. These plants are not abundant on ranges in good condition but do add variety to the forage. On heavily grazed ranges they may become abundant, a situation that indicates poor range conditions. *Agoseris* are found most commonly on moist sites in the ponderosa pine and subalpine meadow types.

The hawksbeards (*Crepis* spp.) have the characteristic yellow flowers (composite head) of the sunflower family to which it belongs. The flowers are petallike or strap-like and 5-toothed at the tips. The seeds are tipped by a ring of whitish, persistent bristles--similar to those of the common dandelion. The stems are from 1 to 2-1/2 feet high, usually branched and leafy. The grayish-white basal leaves are covered with hairs, lance-shaped in outline, and normally cut into linear or toothed sections or lobes, with the ends prolonged into tapering tips. The taproot is tough and deeply rooted. Plants contain a white milky juice.

Although all classes of livestock seem to graze the hawksbeards, sheep appear to be especially fond of them.

Hawksbeards are not abundant in the Southwest. They are found on open sites on well-drained, often stony, soils of the ponderosa pine, pinyon-juniper woodland, and chaparral types.



Figure 61. --*Crepis acuminata* Nutt. (Tapertip hawksbeard)

FORBS

Chimaya (*Cymopterus fendleri* A. Gray), not shown, is a low-growing, taprooted, perennial herb with deeply lobed basal leaves. The flower head is a flat-topped cluster of flowers (similar to that of a carrot seed head) and may be white, yellow, or purple in color.

Although this species may be grazed by all classes of livestock, sheep especially seem to relish it. It is widespread in the sub-alpine meadow, ponderosa pine, pinyon-juniper woodland, and short-grass plains types.

Alfilaria (*Erodium cicutarium* (L.) L'Her.), also called heronbill and filaree, is an annual plant belonging to the geranium family. The leaves at first form only a basal rosette but also appear later on the stems as they develop. The leaves are finely divided and hairy. The flowers are borne on stalks in umbrella-shaped clusters. Flowers vary in color from pink to purple. Each seed is tipped by an elongated tail which coils spirally at maturity. This device assists the pointed seed to penetrate the soil.

Alfilaria is found in the oak woodland, chaparral, semidesert grassland, and desert

shrub types where it furnishes choice spring forage for all livestock. It begins growth early in the spring and it may even provide winter forage if seeds germinate following fall rains. Plants usually mature rather rapidly, dry up, and soon disappear. It tends to hug the ground closely on heavily grazed ranges, thus protecting itself somewhat. However, alfilaria has marked ability for reproducing itself and is an aggressive invader of desert ranges even under heavy grazing. It is a native of the Mediterranean region that was introduced into the United States.



Figure 62. --Erodium cicutarium (L.) L'Her. (Alfilaria)



The various species of geranium (Geranium spp.) vary considerably in growth habits. The stems may occur singly or several may arise from a single base; plants vary from 4 to 36 inches in height. The leaves may be basal or attached to the stems. The leaves are palmately lobed. Geraniums are recognized by the distinctive odor which is given off when the leaves are crushed; by their peculiar fruiting structure which resembles a May-pole; and by the two small, leaflike bracts where the leaf stalks join the stem. Geraniums are fair forage in the Southwest, especially for sheep. Deer graze both the flowers and leaves. Geraniums usually grow in rich soil in subalpine meadow and ponderosa pine types.

Figure 63. --Geranium richardsonii Fisch. & Trautv. (Richardson geranium)

The hawkweeds (Hieracium spp.) are hairy, glandular or occasionally smooth perennial herbs from 1 to 2 feet tall. Leaves are mostly basal; stem leaves are alternate. The leaves may have smooth, slightly toothed, or wavy-margined edges. The flower heads are yellow, orange, red, pink, or sometimes white. The individual flower heads are columnar or cylindrical in shape and are crowned with fragile, tawny, brown, or dull-white bristles. Most of the hawkweeds contain a milky juice.

Hawkweeds grow on a variety of sites; they are found primarily in the subalpine meadow and ponderosa pine types. Ordinarily hawkweeds are present only in minor amounts and occur with other forbs such as mountain-dandelion and beard tongue, and several grass species.

The majority of the hawkweeds are grazed by sheep. They are also considered fair forage for cattle. Several of the species are grazed by game.



Figure 64. --Hieracium sp. (Hawkweed)



Peavines (*Lathyrus* spp.), as a group, are comprised of plants which are mostly smooth, weak-stemmed, trailing or climbing herbs with divided leaves. The pealike blossoms, divided leaves which usually terminate in a tendril (the tendril is sometimes reduced to a tip or small appendage), and the frequently four-sided weak stems, usually distinguish this group from most of the other range plants.

Peavines are widely distributed on rangelands. In the Southwest they are found in the subalpine meadow, ponderosa pine, and pinyon-juniper woodland types. They grow in a number of sites varying from moist to dry, grass or weed, and open or timbered.

Peavines vary in palatability. Usually the trailing or climbing ones with tendrils are more palatable than the erect-stemmed ones and are generally considered fair to good forage for cattle, sheep, and goats. Deer are quite fond of them. The peavines must be utilized before maturity, for they do not cure well but dry up and largely disappear after the first frosts. Some species have extensive root systems with horizontal rootstocks and are able to withstand considerable grazing.

Figure 65. -- *Lathyrus leucanthus* Rydb. (Aspen peavine)

Wright deer-vetch, also known as red-and-yellow-pea, is a small perennial herb, normally 4 to 12 inches tall. The leaves are small, composed of several leaflets, and are delicate and numerous. The stems are slender, much branched, and covered with fine grayish hairs. The flowers are pealike, bright yellow in color, marked with red. The pods are slender, and from 1/2 to 2 inches long. The plant has a deep taproot.

Wright deer-vetch is found in the ponderosa pine, pinyon-juniper woodland, oak woodland, and chaparral types. It is highly palatable for all classes of livestock, especially sheep. It is also a good deer forage. It should be quite nutritious with a high protein content, particularly after the pods are formed. This species may often furnish considerable forage in local areas on ranges in good condition. It is associated with palatable bunchgrasses such as mountain muhly, bromegrasses, Arizona fescue, and Junegrass. Wright deervetch becomes sparse on range in unsatisfactory condition, where it is replaced by snakeweed, pingue, or other unpalatable plants.



Figure 66. --Lotus wrightii (A. Gray) Greene (Wright deervetch)



Bluebells (*Mertensia* spp.), also called lungworts in some localities, are succulent perennial herbs, with showy blue or purple, bell-shaped flowers. These flowers occur in nodding, terminal clusters. The petals of the flowers are united into a 5-lobed, bell-shaped tube. The leaves are alternate, smooth and succulent, with smooth margins. Different species vary greatly in height; some species are 4 or 5 inches tall while others are as much as 3 or 4 feet high.

Bluebells are found mainly in the sub-alpine meadow and ponderosa pine types. Although all species seem to be relished by sheep, only the taller species are eaten readily by cattle. The value of bluebells for cattle forage varies with localities. Often sheep, and to some extent cattle, graze bluebells so intensively that new plants are produced only from rootstocks. However, if reproduction by seed is prevented for an extended period by over-utilization, bluebells may disappear. Deer are also fond of these plants.

Figure 67. --*Mertensia arizonica* Greene. (Arizona bluebell)

Woolly Indianwheat is a small, silvery-colored annual herb from 4 to 8 inches high (although under the most favorable conditions it may be somewhat taller). The leaves are basal, narrow, and densely soft-hairy. The flowers are small and inconspicuous in a dense woolly, cylindrical spike from 1 to 3 inches long.

Woolly Indianwheat is found mainly in the semi-desert grassland and desert shrub types but it also occurs in the oak woodland, northern desert shrub, chaparral and short-grass plains types. It is considered fairly good to good forage for cattle and sheep and is one of the most valuable late-winter and early spring annuals. The dense and relatively large seed heads are the most palatable part of the plant. Woolly Indianwheat is abundant only during winters of favorable rainfall, when there is an abundant seed supply, and perennial grasses are scarce.



Figure 68. --Plantago purshii Roem. & Schult. (Woolly Indianwheat)



Clovers (*Trifolium* spp.) are either perennial or annual leguminous herbs with the flowers arranged in heads or short spikes. The small flowers are the characteristic pea-type. The leaves are compound; they consist of 3 (4 to 7 in a few species) leaflets. Clovers in the Southwest are found primarily in the subalpine meadow and the ponderosa pine types.

In general, the clovers are excellent forage for cattle and sheep. Deer are especially fond of them. Some of the perennial clovers grow in pure stands and form rather dense sod which withstands trampling and grazing well. Many clovers increase soil fertility and tilth, particularly on moist sites along creek bottoms and meadows.

Figure 69. --*Trifolium longipes* Nutt. (Longstalk clover)

American vetch is a smooth, trailing or climbing perennial herb, with weak vinelike stems 1 to 4 feet long, and sharply four-sided. The leaves are pinnately divided. The flowers are the characteristic pea-type, bluish-purple, up to 3/4 inch long. The pods are flat, two to several seeded, and up to 2 inches long.

American vetch is found in subalpine meadow and ponderosa pine types where it is one of the choice forage species for all classes of livestock. Deer seek it out. Because of its fragility, coupled with the fact that all of its above-ground parts are edible, it does not withstand close grazing well and is one of the first plants to decrease under such use. It is found growing on ranges in good condition.



Figure 70. --*Vicia americana* Muhl. (American vetch)



Serviceberries
(*Amelanchier* spp.) are large shrubs or small trees up to 15 feet high with alternate branching. The leaves, up to about 2 inches long, are usually oval or rounded, with square-cut or rounded tops, dark green on the upper surface and lighter on the underside. Leaf margins are usually saw-toothed above the middle and entire near the base. The showy flowers have five long white petals. The fruit, which is berry-like, is juicy, usually purplish or bluish-black in color, and is highly palatable.

These shrubs are fairly good browse for cattle and good for sheep. They are important browse for deer, especially on summer range. On the average range, they are utilized chiefly after mid-summer, when the more palatable grasses and herbs have matured. They commonly withstand grazing well; however, the smaller individuals may be killed by continuous close use.

Serviceberries grow under a wide variety of site conditions. They are found on dry rocky slopes or deep soils in full sunlight or in partial shade of coniferous timber. In some places they form rather dense undergrowth but usually they are associated with other shrubs.

Serviceberries are most commonly found in the ponderosa pine, pinyon-juniper woodland, oak woodland, and chaparral types.

Figure 71. --*Amelanchier alnifolia* Nutt. (Saskatoon serviceberry)

The sagebrushes (*Artemisia* spp.) are small to large perennial herbs or shrubs, usually with deep and wide-spreading root systems. Leaves are small (1/4 to 3/4 inch), alternately arranged, and one- to three-toothed. Flowers are borne in small, compact heads (typical of composites) arranged along a flower stem. There are no hairs on the seeds.

Big sagebrush (*A. tridentata* Nutt.) is the best known species, and is easily identified in the field because of its persistent aroma. Large areas in northern Arizona and New Mexico are dominated by this species, although its greatest abundance is reached in the Great Basin Region. Palatability of big sagebrush is rather low, but it is grazed by livestock to some extent, especially sheep on winter range when snow covers the more palatable plants. It is grazed well by deer, especially on winter range. Other closely related species are more palatable and furnish valuable browse in winter and early spring. Some species are toxic when taken in large quantities.

Areas dominated by robust plants of big sagebrush often are good sites for range seeding. Big sagebrush is most common in the northern desert shrub type.

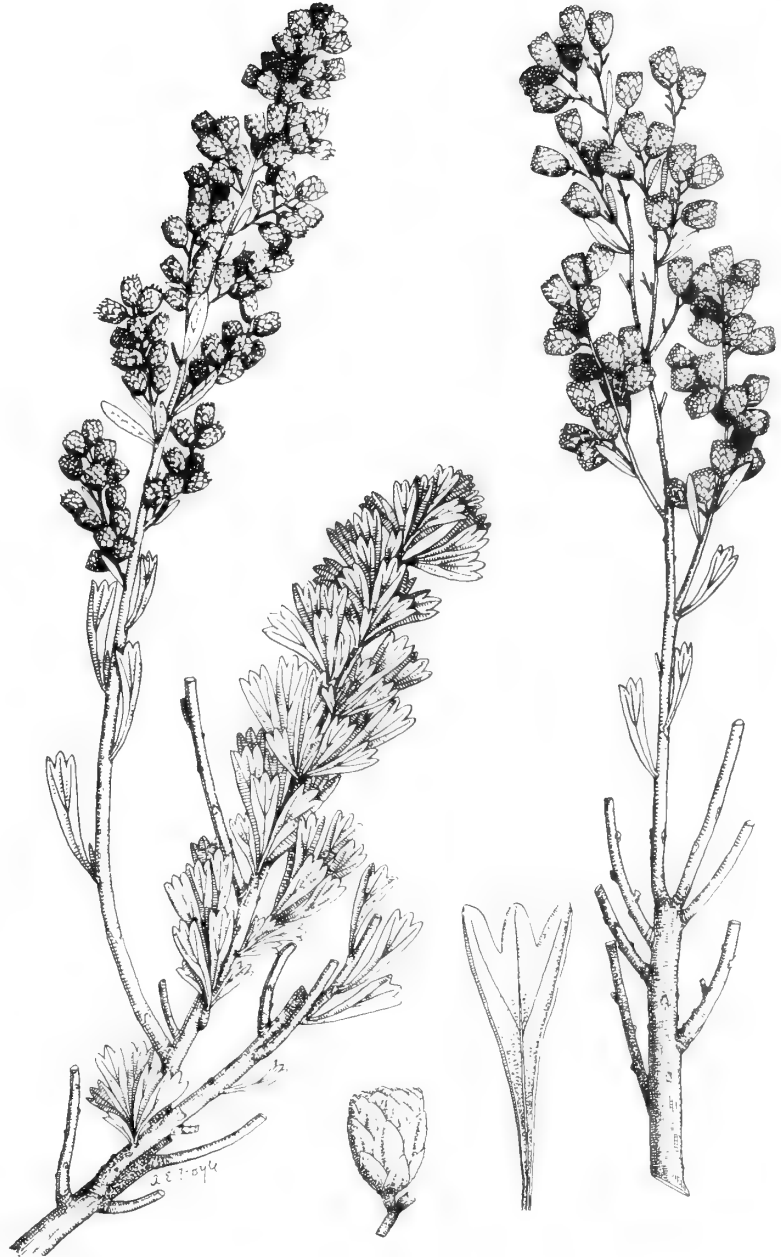


Figure 72. --*Artemisia tridentata* Nutt. (Big sagebrush)



Fourwing saltbush, also called "chamiza" is a grayish-white, scurfy shrub, branching freely almost from ground level, and occasionally reaching a height of 6 to 10 feet. Leaves are alternate, and somewhat clustered, stalkless and narrow, and about $\frac{3}{8}$ inch wide and 2 inches long. The male and female flowers are usually borne on separate plants near the end of the branches. The fruit or seed is one-celled with four conspicuous wings or bracts.

This species, widespread throughout the Southwest, is found in the pinyon-juniper woodland, northern desert shrub, short-grass plains, semidesert grassland, and desert shrub types. It is drought resistant and inhabits dry, saline, or alkaline soils.

Fourwing saltbush is one of the most palatable shrubs in the Southwest. The leaves, stems, flowers, and fruits are cropped by all classes of livestock except horses, which seem to graze saltbush only in the winter when other forage is sparse. Deer often browse on it in the winter. Plants withstand grazing well. Under prolonged overgrazing the bushes become weakened or succumb entirely. Because the seeds are highly palatable, reproduction of saltbush is often sparse where summer grazing is too heavy. It can be successfully seeded on deteriorated areas when proper techniques are used.

Figure 73. -- Atriplex canescens (Pursh) Nutt. (Fourwing saltbush)

Wright baccharis (Baccharis wrightii A. Gray), not shown, is a woody-based shrub averaging about 30 inches high. The leaves are small, usually less than 1/2 inch long, narrow, with smooth edges. The entire plant has a blue-green sheen.

Wright baccharis is one of the most palatable browse species in the Southwest. Apparently it cannot withstand grazing too well as Goodding⁵ has reported that it has disappeared from many areas because of overgrazing. It is highly drought resistant and is often found on saline soils. The species is an important source of browse for desert mule deer. It grows primarily in the semidesert grassland and desert shrub types.

False-mesquite is a woody, low, shrub that frequently grows as high as 2 feet when not grazed; on the open range it is normally from 3 to 12 inches in height. The branches are rather stiff and bluish gray in color. Young twigs are soft-hairy. The flowers are few, and in round clusters; the stamens (male part) are numerous, purplish in color, and protrude in a plum-like cluster. The leaves are deciduous and are similar to those of mesquite or catclaw, but smaller. Plants are most common on the warm, open, sunny slopes and exposures of dry mesas and foothills.

Under optimum site conditions and grazing use false-mesquite may comprise up to 25 percent of the ground cover. More usually it is found as scattered individuals that constitute only a minor part of the composition. Grasses with which it is commonly associated include most of the gramas, curlymesquite, and three-awns.

False-mesquite is one of the most palatable browse plants of the semidesert grassland, chaparral, and oak woodland types. All classes of livestock will browse it. Also, desert mule deer are fond of its young succulent herbage. Plants start growth early in the spring if moisture is available. The succulent shoots, leaves, flowers, and seed pods are especially palatable. Being a low, easily accessible,



open-crowned, unarmed shrub, it is ordinarily grazed very closely on overgrazed ranges. Generally on a properly grazed range 40 to 60 percent of the current year's growth is utilized.

⁵ Goodding, Leslie N. Note on native and exotic plants in Region 8, with special reference to their value in the soil conservation program. U. S. Dept. Agr. Soil Conserv. Serv. Bul. 247, 152 pp., illus. 1938.

Figure 74. --Calliandra eriophylla Benth. (False-mesquite)



Fendler ceanothus, often called buckbrush, is a low, rather loosely branched shrub averaging from 1 to 3 feet in height, with grayish-white hairy, commonly sharp-pointed twigs. The leaves are alternate, three-ribbed, normally small ($1/2$ to 1 inch long) and somewhat silky. The flowers are small, white, and numerous in rather showy clusters at or near the ends of the branches of the loose open crowns. The seed pods are about $3/16$ inch in diameter, globe-shaped with a flattened top and three-celled.

Wide distribution, local abundance, tender leaves, and palatable twigs make this an important browse plant. Palatability ranges from fair to good for cattle, and from fairly good to good for sheep. Deer take considerable amounts on summer ranges. Horses also browse it frequently. Too close utilization of this shrub, particularly where abundant, indicates improper range management.

Fendler ceanothus is commonly found as scattered individuals from the upper part of the pinyon-juniper type to the spruce-fir forests. It may be rather prominent in local areas, especially in the ponderosa pine type.

Figure 75. --Ceanothus fendleri A. Gray (Fendler ceanothus)

Desert ceano-
othus is a stout,
 rather heavily
 branched, some-
 times evergreen
 shrub, commonly
 2 to 5 feet in height.
 The short, stout,
 rigid twigs are pale
 and finely woolly
 when young and
 grayish to olive
 green in color
 when mature, and
 usually have blunt-
 ish but spinelike,
 mostly leafless tips.
 The leaves are mainly ever-
 green, single or sometimes
 clustered, thick, leathery,
 1/4 to 1/2 inch long, grayish
 green, oval in shape, and hairy
 on the underside. The flowers
 are small, white, and borne in
 clusters toward the ends of the
 branches.

Desert ceanothus is fair
 to good winter and early spring
 browse for all classes of live-
 stock, especially goats. This is
 one of the most important browse
 plants for deer in the chaparral
 ranges of the Southwest. On
 heavily populated deer ranges
 this is one of the first species
 to disappear. It can usually be
 grazed yearlong, but close use,
 at least on summer cattle and
 sheep range, indicates over-
 stocking and possible range
 deterioration.

Desert ceanothus grows
 mainly on slopes in dry, clayey,
 or sandy soils of the pinyon-
 juniper woodland, chaparral, and
 oak woodland types. It is fre-
 quently found associated with
 oaks, manzanita (*Arctostaphylos*
 spp.), species of *cercocarpus*,
 and silktassel.

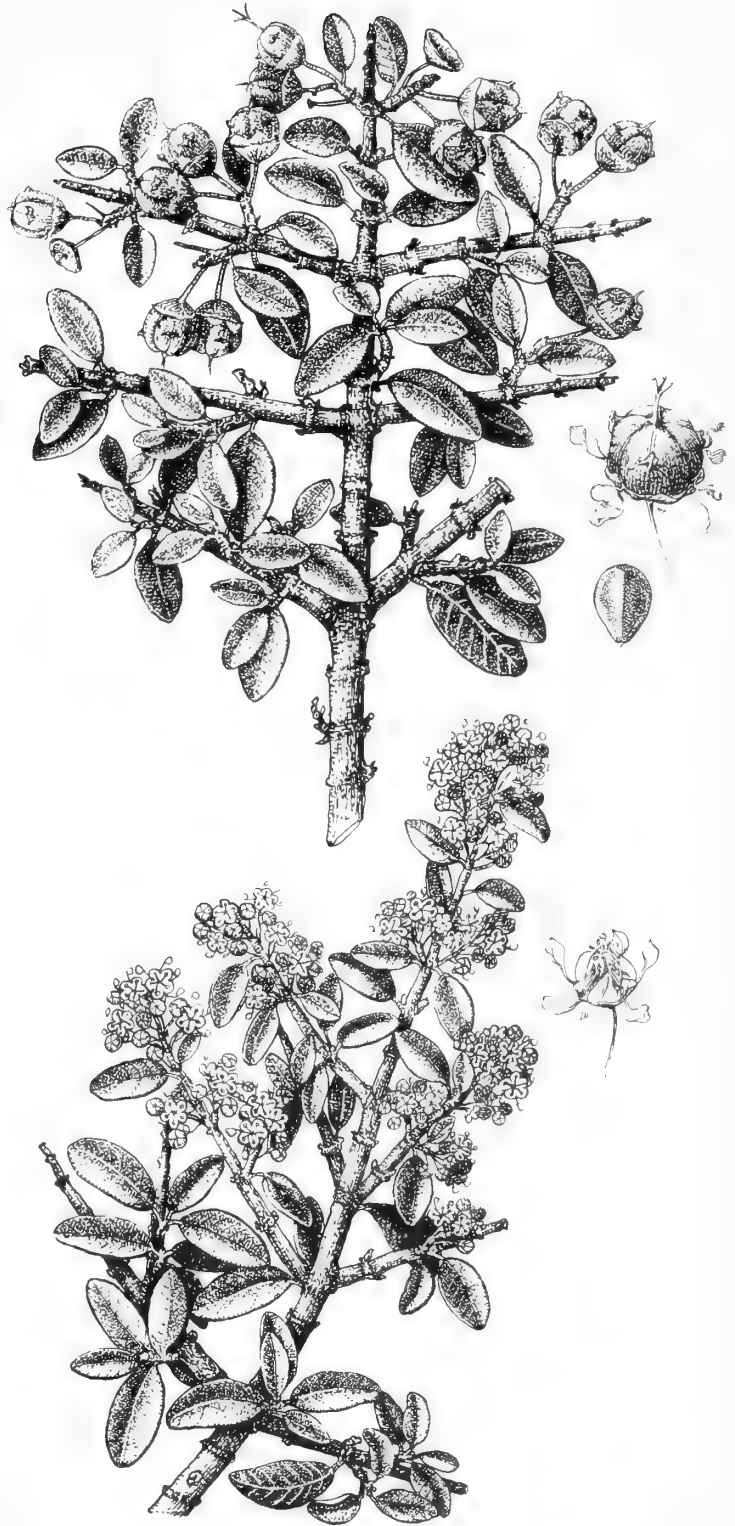


Figure 76. --*Ceanothus greggii* A. Gray (Desert ceanothus)

TREES AND SHRUBS

Hairy cercocarpus (*Cercocarpus breviflorus* A. Gray), not shown, or hairy mountainmahogany is on an average about 15 feet high, with thick leaves about 2 or 3 times as long as wide, pale green in color, and with smooth edges. The flowers are inconspicuous, greenish-white to reddish in color, while the fruits are tipped with a long, feathery curved or twisted tail. The long tail assists the seed to penetrate the soil.

Hairy cercocarpus is an important browse plant for all classes of livestock. It is usually rated as good to very good for cattle and excellent for sheep. It affords yearlong grazing. This species is an important browse for deer at elevations from 5,500 to 8,000 feet. It is common on dry slopes and mesas as a secondary species to several scrub oaks. It is found in the pinyon-juniper woodland, oak woodland, and chaparral types.



True cercocarpus, more commonly known as true mountainmahogany in the Southwest, is normally a bushy shrub 2 to 10 feet high. Occasionally it becomes a small tree up to 20 feet tall. The leaves are alternate or somewhat clustered, usually persistent, up to 2 inches long and 1 inch wide, broadly egg shaped, often wedge shaped at base, triangularly toothed, silky on the upper side, and densely hairy on the underside. Leaves are thickly veined. The flowers are inconspicuous and borne in the axils of the leaves. Fruits are tipped with a feathery tail as in the case of the hairy cercocarpus. The branches are soft-hairy when young and reddish in color, but become gray or brown with age, and are marked by ringlike leaf scars.

True cercocarpus is from good to excellent in palatability, depending on class of livestock. Plants withstand grazing well. At the higher elevations this plant furnishes much browse for deer. At lower elevations it is used much less.

In the Southwest, true cercocarpus is found in the ponderosa pine, pinyon-juniper woodland, and oak woodland types where it grows as scattered plants on dry slopes with thin soils.

Figure 77. --*Cercocarpus montanus* Raf. (True cercocarpus)

Cliffrose is a leafy, evergreen shrub, ordinarily from 3 to 12 feet high, but under the most favorable conditions it may be 20 to 25 feet high. The bark of the young plants and twigs is somewhat roughened and has papery scurf; the bark on the older parts hangs in long shreds. The leaves are small, evergreen, leathery in texture, usually with 5 to 7 short, linear lobes, dark green above, white-hairy beneath with the margins curled under. The leaves are usually borne at the ends of short, spurlike branches. Flowers are solitary, about $\frac{3}{4}$ inch across, white to sulfur-yellow in color. The seeds are hairy and each is tipped by a long (up to 2 inches) feathery tail.

Cliffrose is widely scattered; it is found in the ponderosa pine, pinyon-juniper woodland, oak woodland, and chaparral types. It is an important and valuable browse for cattle and sheep. In many localities it furnishes the bulk of the spring-fall and sometimes winter browse for deer. It is the key browse species on the winter deer range of the Kaibab Plateau.

Cliffrose markedly increased under protection from livestock but decreased under grazing on study areas in the pinyon-juniper type. Furthermore, as density of the tree overstory increased, the production and density of cliffrose and other valuable browse decreased.

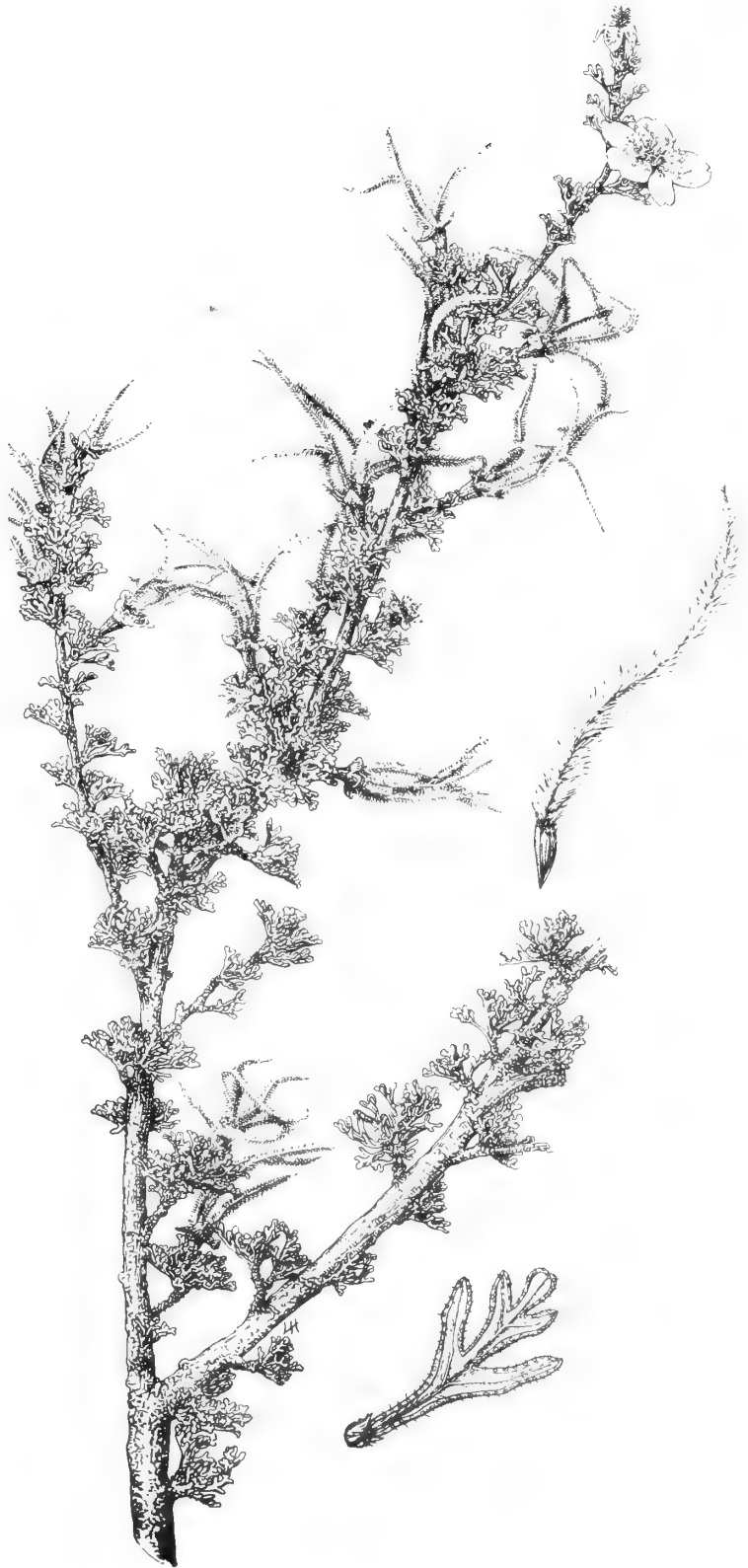
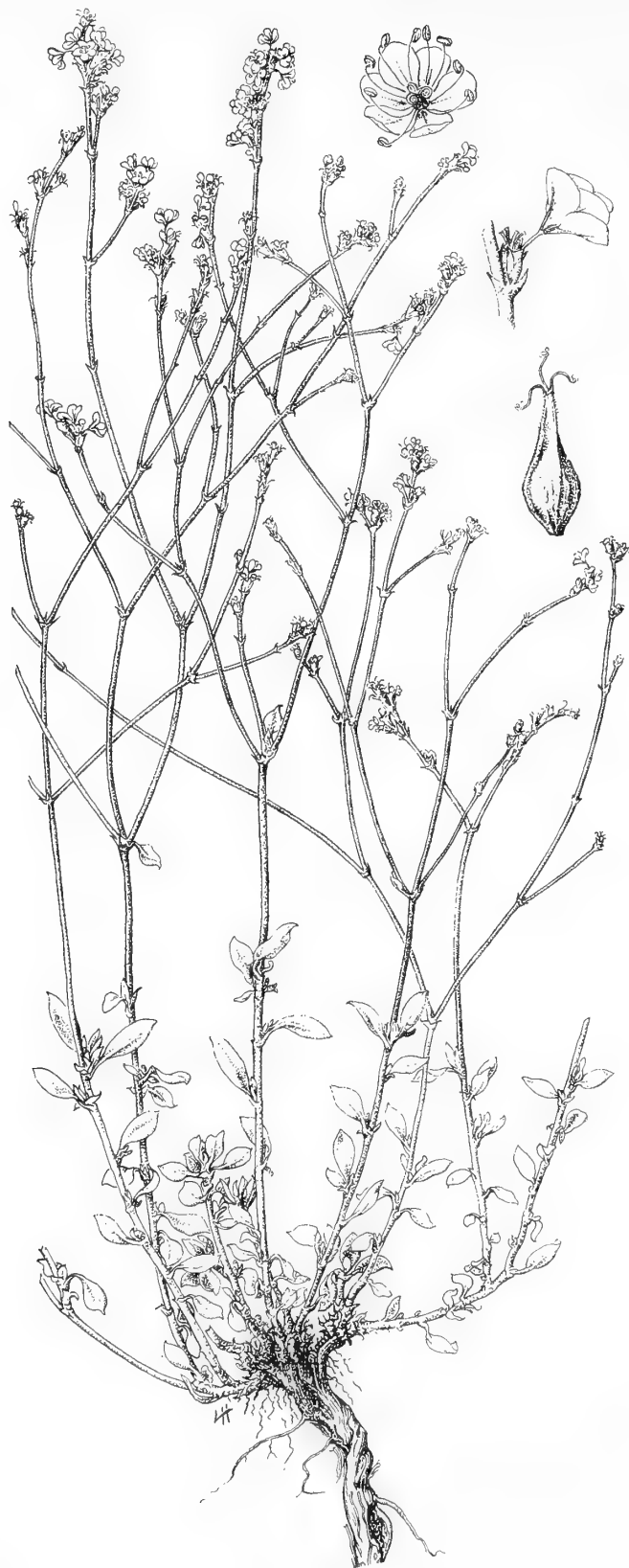


Figure 78. --Cowania mexicana D. Don (Cliffrose)



Wright eriogonum, also called Wright buckwheat, is a low, white-woolly, perennial shrub usually less than 2 feet tall. It commonly has a base or crown growing close to the surface of the ground from which the much-branched stems emerge. The leaves are alternate, up to about 1 inch long, reverse lance-shaped, sharp-pointed at the tips, and are covered with white, wool-like, fine hairs. The white or pinkish flowers are borne in heads at the tips of rather short, leafless flower-head stalks. Its appearance which frequently varies, depends on the habitat. For example, it is more dwarfed at lower elevations where it is warmer.

This shrub is found primarily in the pinyon-juniper woodland, oak woodland, and chaparral types where it is considered fairly good forage for goats and sheep and fair for cattle. In some localities it is the opinion that Wright eriogonum affords from poor to fair spring and summer feed for sheep, and fair to fairly good winter feed. Desert mule deer are fond of this species. On heavily grazed ranges, Wright eriogonum disappears quickly, where it is often replaced by burroweed and snakeweed.

Rosemary eriogonum (*E. fasciculatum* var. *polifolium* (Benth.) Torr. & Gray), not shown, is very similar to Wright buckwheat and replaces it on the drier, more desertlike habitats. On some areas it is very abundant. The palatability of the two species is about the same.

Figure 79. --*Eriogonum wrightii* Torr. (Wright eriogonum)

Winterfat, also variously called white sage and sweet sage, is a bushy-branched, shrubby perennial 1 to 3 feet tall. The woody crown or base gives rise to many erect, round, herbaceous stems. The stems are covered with rather long, branched hairs, whitish at first but later turning rusty in color. The leaves are alternate, narrow, and from $1/4$ to 1 inch long, with rolled-under edges, and covered with white hairs. The flowers form dense clusters along the stems. The male and female flowers are separate. The plant has a deep taproot with many lateral roots, which help to make this species drought resistant.

As the name implies, winterfat is chiefly valuable on winter ranges where it often furnishes an abundance of palatable and nutritious forage for cattle and sheep. The plant is also relished by deer and elk. Persistent and continuous overgrazing has greatly reduced this plant on many ranges and has completely destroyed it on others. It does well on moderately alkali soils.

Winterfat is a widespread shrub and is found in the pinyon-juniper woodland, northern desert shrub, and short-grass plains types. It is one of several palatable plants that are present on ranges in good condition. Winterfat is intolerant of a tree overstory, and soon gives way as juniper increases in an area.

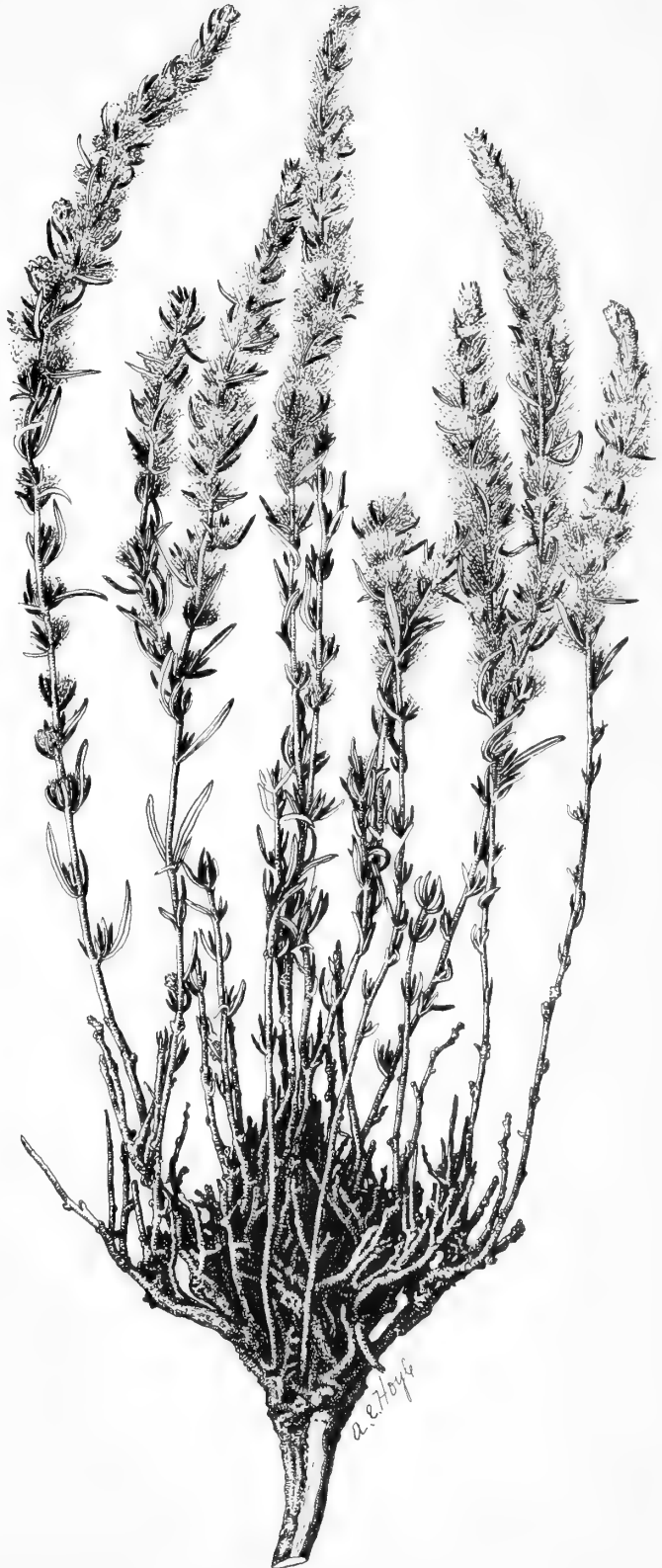


Figure 80. --Eurotia lanata (Pursh) Moq. (Winterfat)



Apache-plume is a many-branched, often evergreen shrub, typically 2 to 3 feet high, but attaining 6 or 7 feet in height under the most favorable conditions. The leaves are small, bunched, somewhat soft-hairy, up to nearly 1 inch long, wedge-shaped in outline, and divided into 3 to 7 linear, blunt-tipped lobes. The flowers are large, showy, white, and somewhat resemble wild roses. The seeds are soft-hairy, and tipped by long (up to 2 inches) leathery tails which have a reddish tinge when mature.

In general Apache-plume is considered a good forage plant. Plants furnish some winter browse for deer. As one would judge, its chief value is for winter forage. It endures close grazing well, shows excellent "comeback" ability, and is a natural aid in erosion control.

Apache-plume may grow under a fairly wide range of conditions; it is found in the pinyon-juniper woodland, oak woodland, and chaparral types. Its best development is attained in deep, moist, rich sites, such as open canyon bottoms and the sides of arroyos.

Figure 81. -- Fallugia paradoxa (D. Don) Endl. (Apache-plume)



Wright siltassel is a shrub from 1-1/2 to 10 feet tall, with thick, evergreen, leathery, sharp-pointed, smooth-edged leaves which are hairy and gray on the upper surface but hairless and yellow on the underside. The leaves are ovate to oblong in shape and rather large. The branches tend to be four-angled. The bark of the younger branches is smooth and dark red in color; that of the older stems is somewhat furrowed and grayish.

While in many localities, Wright siltassel is considered worthless for forage, in the Southwest it is sometimes moderately grazed by cattle from December to June. Chapline⁶ reports its palatability rather high for goats, especially in the summer. This species furnishes a stable source of browse for deer, especially in the higher chaparral zone. Practically the entire plant is permeated with an intensely bitter quininelike flavor, which may account, in part at least, for its low palatability.

Wright siltassel is found in the pinyon-juniper woodland, oak woodland, and chaparral types where it is a component of better-condition ranges. More palatable species with which it occurs may be noticeably grazed on ranges in good condition before siltassel is taken.

⁶ Chapline, W. R. Production of goats on far western ranges. U. S. Dept. Agr. Bul. 749, 35 pp., illus. 1919.

Figure 82. --*Garrya wrightii* Torr. (Wright siltassel)

TREES AND SHRUBS

Littleleaf krameria (Krameria parvifolia Benth.), not shown, also called range ratany, is a low, bushy, diffusely branched shrub from 1 to 2 feet high. The leaves are alternate, linear, and covered with soft, silky hair. The flowers are purple in color, while the fruits are burlike, somewhat egg- or heart-shaped, and covered with delicate, purple, barbed spines. When this shrub is abundant, its bluish-green foliage transmits a dull bluish tint to the landscape.

Littleleaf krameria is fair to good forage for cattle and sheep. Desert mule deer also graze it well. During dry years it is ordinarily cropped closely and is a good emergency forage. Normally, the new growth is readily available

to browsing animals, but under continued close cropping the shrubs become slightly hedgy, with spinelike twigs, thus protecting themselves to some extent. On an average, from 25 to 50 percent of the current year's growth should be used on a conservatively grazed range.

Littleleaf krameria is found in the chaparral, and semidesert grassland types most often on gravelly soils in association with catclaw, false-mesquite, Wright eriogonum, galleta, and gramas. Usually it grows as scattered individuals although it may be locally abundant. On deteriorating range areas, littleleaf krameria will be closely hedged.

Rough menodora (Menodora scabra A. Gray), not shown, is a perennial herb or under-shrub from 12 to 30 inches high, bluish gray in color. The upper leaves are greatly reduced and the upper portion of the stems are often practically naked. The flowers are yellow, rather showy, and funnel shaped. The fruit

consists of capsules, with each capsule bearing or containing four seeds.

Rough menodora is found on the pinyon-juniper woodland, oak woodland, chaparral, and semidesert grassland types. It is reported to be highly palatable to all classes of livestock. Deer graze it heavily.

The cacti (Opuntia spp.) are shrubs or perennial herbs, 1 to 10 feet tall, characterized by jointed stems which are round or flattened. The leaves are small, fleshy, and inconspicuous with many bristles at the bases. Stems are armed with barbed spines. Flowers are bright shades of yellow, orange, or red, and quite conspicuous. The fruit is usually fleshy, often spiny, and contains numerous hard seeds.

Cacti are widely distributed and very abundant on some ranges. Since cacti are easily disseminated by livestock, they have thickened and spread on many rangelands of Arizona and New Mexico. The chollas are

considered to be nuisance plants. Fruits of most species of the pricklypear and cholla groups are eaten by livestock, deer, javelina, and many smaller species of wildlife. In the early days of livestock grazing, Engelmann pricklypear (O. engelmanni Salm-Dyck) was valued as emergency forage for livestock, particularly cattle. Spines were singed off with torches to make the fleshy joints more palatable. With commercial supplements now available, this practice is rare. The cacti are found in greatest abundance in the pinyon-juniper woodland, chaparral, oak woodland, semidesert grassland, short-grass plains, and desert shrub types.

FLOWER IN LONGITUDINAL SECTION

TREES AND SHRUBS

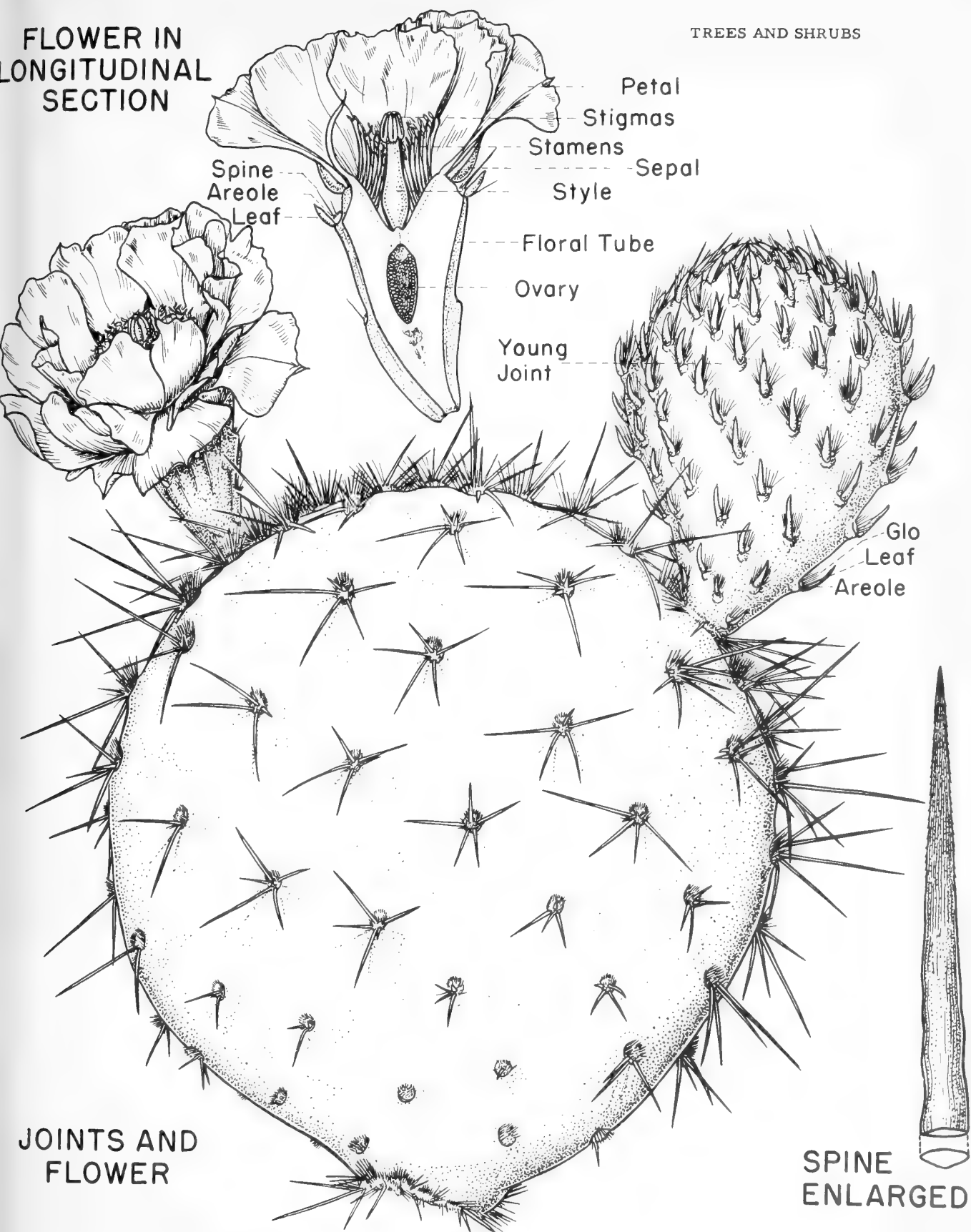
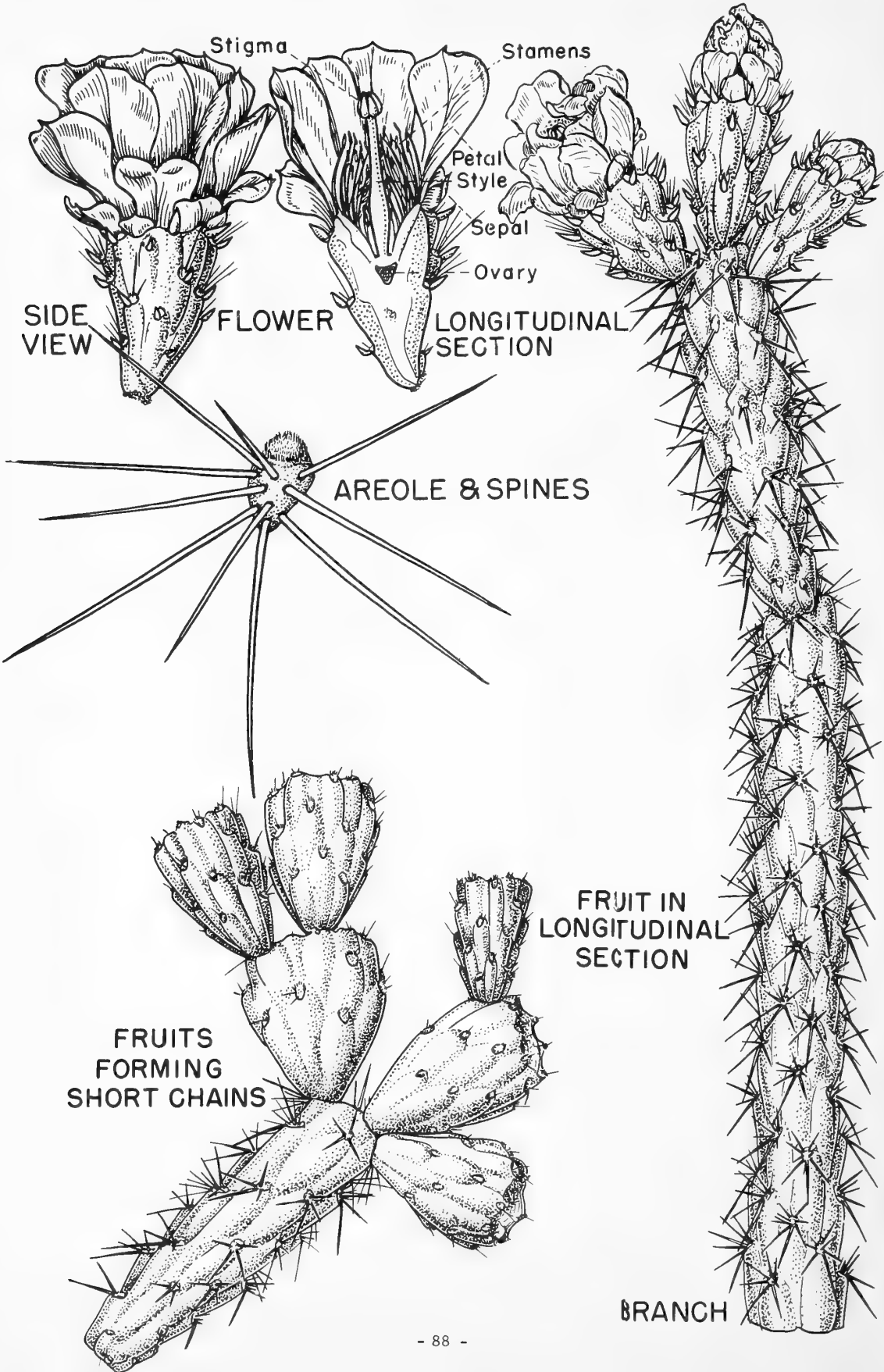
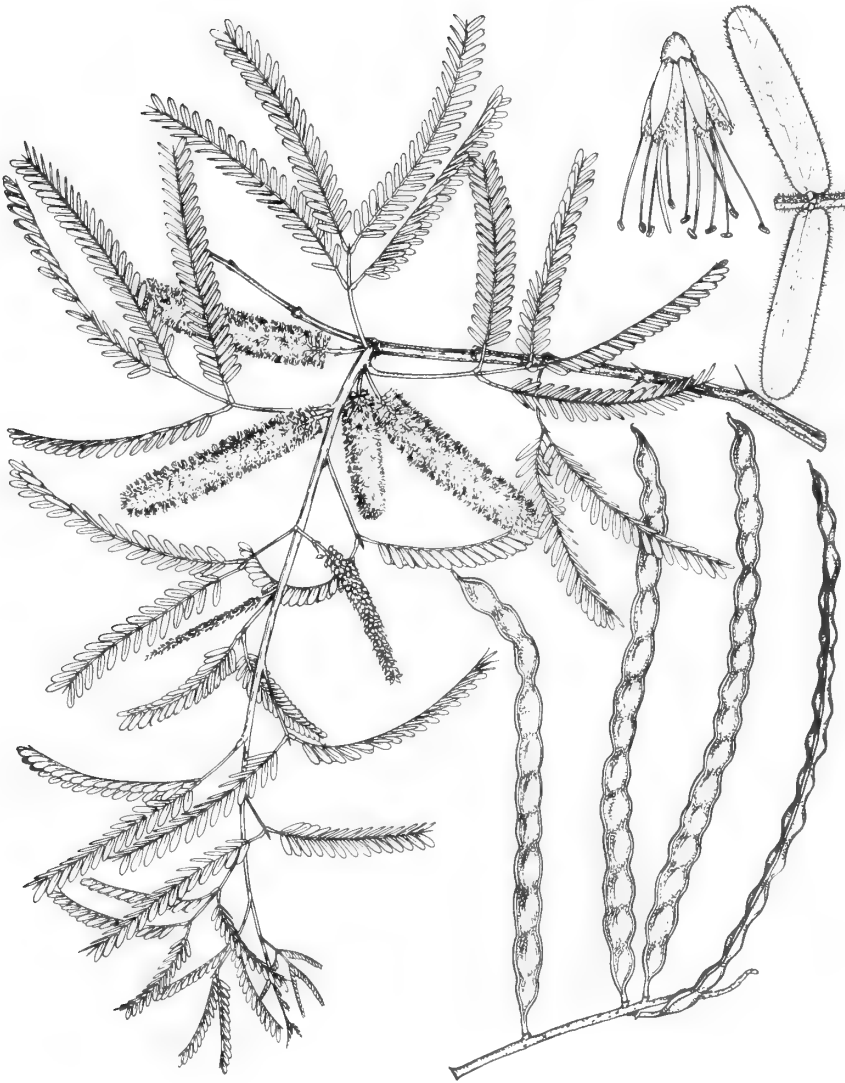


Figure 83. --*Opuntia* spp. (Pricklypears)
(Courtesy of Dr. Walter S. Phillips, University of Arizona)

Figure 84. --*Opuntia* spp. (Chollas)
(Courtesy of Dr. Walter S. Phillips, University of Arizona)





Mesquites (*Prosopis* spp.) are deciduous shrubs or trees from 2 to 10 (sometimes 50) feet tall. The most common belong to the species *P. juliflora* (Swartz) DC. Three varieties of this species are recognized: velvet mesquite (*P. juliflora* var. *velutina* (Woot.) Sarg.), western honey mesquite (*P. juliflora* var. *torreyana* L. Benson), and honey mesquite (*P. juliflora* *glandulosa* (Torr.) Cockerell). Leaves are dark green and compound (divided into many small leaflets). Twigs are armed with spines 1/4 to 2 inches long. Flowers are greenish yellow, small, and borne in cylindrical clusters 2 to 3 inches in length. These develop into beans 4 to 8 inches long, which contain 10-20 seeds. Several crops of beans may be produced during the growing season.

The three varieties of mesquites are similar in forage value. Leaves are taken to some extent by livestock; beans are sought out and eaten avidly, presumably because of their high sugar and protein content. Leafage is valued by stockmen during droughts and in early spring when other forage is scarce.

Beans are eaten by deer, javelina, quail, doves, and other smaller species of wildlife. Mesquites also furnish shelter for livestock and protective cover for wildlife. There is considerable concern about mesquite invasion of grasslands, because even though mesquite furnishes some forage it does not compensate for the perennial grass replaced. The mesquites are most prominent in the oak woodland, semi-desert grassland, and desert shrub types.

Figure 85. --*Prosopis juliflora* (Swartz) DC. (Mesquite)
(Courtesy of Dr. Walter S. Phillips, University of Arizona)



Antelope bitterbrush is a diffusely branched, semi-erect, grayish green, low-growing shrub, normally from $1\frac{1}{2}$ to 6 feet tall. The woody, irregularly branched stems are covered with brown or grayish-colored bark. The leaves are usually clustered, wedge-shaped, $\frac{1}{4}$ to $\frac{3}{4}$ inch long, three-toothed at the end, green, fine-hairy on top and white-woolly beneath with rolled-under margins. The flowers are yellow. The seeds are spindle-shaped and tipped with a tapering beak.

Antelope bitterbrush is one of the most important and widespread shrubs on western ranges. However, in the Southwest, it is restricted primarily to the ponderosa pine and pinyon-juniper woodland types. Some differences of opinion seem

to exist regarding its forage value under Southwestern conditions. In general, the palatability is considered good to excellent for cattle, sheep, and goats. It furnishes a staple winter browse on many deer ranges. It is seldom grazed by horses. Bitterbrush appears to withstand grazing well, but it can be killed out by excessive use. If close grazing continues for a period of time, it may assume a more or less hedged, prostrate, spreading form.

Figure 86. -- Purshia tridentata (Pursh) DC. (Antelope bitterbrush)

Gambel oak is a deciduous shrub or tree from 6 to 50 feet tall. The bark is gray and flaky. Leaves are alternately arranged, large (2 to 5 inches) lobed (usually over half way to midrib); lobe tips rounded. Flowers and acorns are similar to shrub live oak.

Gambel oak furnishes valuable forage for livestock and deer on summer ranges and some winter ranges, mainly because of its abundance, wide distribution, and general scarcity of other browse. When more palatable browse is present, Gambel oak is more lightly used. Acorns are highly valued mast for livestock, deer, and turkeys. Gambel oak is most common in the ponderosa pine, pinyon-juniper woodland, and chaparral range types.



Figure 87. --Quercus gambelii Nutt. (Gambel oak)

Shrub-live oak, often called turbinella oak, is an evergreen, many-branched shrub from 3 to 13 feet tall. Leaves are borne singly, alternately arranged on stems; are elliptical to ovate in shape; are without hairs, with the upper surface a dull green and the lower surface whitish or yellowish. Margins are many toothed. Plants are monoecious, the male and female flowers borne separately. Male flowers occur in drooping appendages; female flowers are clustered with each flower producing one acorn.

Shrub-live oak is an important component of the chaparral of central Arizona and southwest New Mexico. Although not highly palatable, it is used by cattle and deer in winter, often heavily during drought years. Acorns are of intermittent abundance, but when available are used heavily by deer, pigeons, and quail. Plants sprout profusely when fired, or the top is otherwise killed back. Young sprouts are taken avidly by all classes of browsing animals.



Figure 88. --Quercus turbinella Greene (Shrub live oak)



California jojoba is a bushy, ever-green, bluish-green shrub, commonly 3 to 4, but occasionally as much as 7, feet high. The leaves are opposite, somewhat leathery, oblong to egg shaped, and 1 to 1½ inches long with smooth margins. The male and female flowers are borne separately on the same plant, the former in clusters while the latter are solitary. The fruit is a capsule containing a single, acornlike seed.

California jojoba is one of the most important browse plants in the Southwest. It is found primarily in the chaparral and desert shrub types. Although its palatability varies somewhat according to the accompanying species, it is usually good to very good winter forage and fair summer forage for all livestock. Plants are used yearlong by deer on both chaparral and desert shrub ranges. It withstands heavy browsing well, but may be grazed to the point of near extermination, especially on depleted ranges.

Figure 89. --Simmondsia chinensis (Link) Schneid. (California jojoba)

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